AERONAUTICAL RESEARCH

HEARING

BEFORE THE

SUBCOMMITTEE ON TRANSPORTATION,
AVIATION AND MATERIALS

OF THE

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SCIENCE AND TECHNOLOGY
U.S. HOUSE OF REPRESENTATIVES

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*On assignment to Budget Committee for 97th Congress.

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AERONAUTICAL RESEARCH

TUESDAY, DECEMBER 14, 1982

House of Representatives,
Committee on Science and Technology,
Subcommittee on Transportation,
Aviation and Materials,
Washington, D.C.

The subcommittee met, pursuant to call, at 9:36 a.m., in room 2318, Rayburn House Office Building, Hon. Dan Glickman (chairman of the subcommittee) presiding.

Mr. Glickman. Good morning.

This morning we take up the subject of aeronautical research. I suppose the heart of this subcommittee as it relates to our responsibilities, is the role of Government as well as industry in insuring our aeronautical research is at a point where industry can do their best to, in my judgment, dominate the world aviation industry.

For nearly 70 years, since Congress established the National Advisory Committee on Aeronautics, the Federal Government and the aviation industry have worked closely together. They have done so in a way that confounds the currently fashionable view about the ineffectiveness of Government programs.

In every sense it has been a partnership that is unique not just in its harmony, but also in the results it had produced. To see the evidence, one need only reflect on the decisive role played by U.S. aircraft during World War II and on the unprecedented worldwide commercial success of U.S. civil aircraft.

Yet despite this well-known history, the Office of Management and Budget last year embarked on a plan to withdraw from this longstanding arrangement. The reason given was that federal sponsorship of aeronautical research and technology constituted a subsidy to industry and should be eliminated.

To virtually everyone familiar with the past benefits of Government investment in this area, such shortsighted thinking amounted to ivory tower tinkering with a proven and effective system. They all asked, "Why fix something that isn't broken?" Indeed, I suspect the real reason was nothing more than budget cutting zeal.

Fortunately, others in the administration sought to avoid having such a potentially damaging policy decision made solely in the budget process. The result was a 7-month intensive study to address the question of what role the Government should play in advancing aeronautical research and technology.

The results, as I have read them, are most encouraging. After a monumental struggle by everyone affected, it seems that the administration has finally come to their senses on the importance of aeronautics.

As the subcommittee responsible for this subject, we have followed the twists and turns of this issue from the beginning. Almost exactly 1 year ago we held a hearing that we called "The First 'A' in NASA." Our purpose was to examine the consequences of the then-pending OMB action.

The response from industry and others was overwhelming. Everyone said it would be a grave mistake, both for our national security and economic well-being, to even consider such a radical departure.

In spite of this, OMB persisted with a drastic curtailment of NASA's aeronautics program. It was only with firm action by Congress that funds were restored and the decision reversed.

So, I am delighted that the administration's policy review has come to what I regard as the only responsible conclusion about the necessity for Government support of this vital area. I only hope that the OSTP statement will not be undone by decisions in the 1984 budget.

Today our witnesses are from the aviation industry, who I assume will be not only talking about the OSTP report but about Government policy in general with respect to the aviation industry, realizing that it is being hit now in a similar fashion in the recession as the automobile industry is being hit.

We are pleased to have the witnesses here. I will tell all the witnesses that their entire statements will appear in the record. If they want to summarize their statements—sometimes when I say this people summarize and take longer than if they read their statements, so you be the judge of what you want to do, but your entire statements will be in the record.

Our first witness today is Dr. Victor Reis, Assistant Director, National Security and Space, with the Office of Science and Technology Policy, with the Executive Office of the President.

Dr. Reis, it is a pleasure to have you here. You may begin.

STATEMENT OF VICTOR H. REIS, ASSISTANT DIRECTOR, NATIONAL SECURITY AND SPACE, OFFICE OF SCIENCE AND TECHNOLOGY POLICY, EXECUTIVE OFFICE OF THE PRESIDENT

Mr. Reis. Chairman Glickman, I am pleased to have this opportunity to present a summary of the administration's recently completed study on Federal policy for aeronautics research and technology. I know of your deep interest in this area and your commitment to strong Federal programs.

I am confident that the new policy recommendations will provide the administration, the Congress, and industry with a sound basis for implementing cost effective and beneficial programs in the national interest.

Mr. Chairman, I know you are well aware that one of the reasons for this study was the serious question raised last year about the benefits to the public of continued Federal funding of aeronautics research and technology.

Quite honestly, there was a widespread concern that after decades of Federal support we might be at a point of diminishing returns. Given that concern, the administration felt a responsibility to consider whether the Federal Government could reasonably cut back on nonmilitary aeronautics research that might more appropriately be done by industry.

As we now know, the study, under the direction of the Office of Science and Technology Policy, and conducted by representatives of Federal agencies and White House offices, did not bear this concern out.

The study group, which also included observers from industry and academia, focused essentially on two concerns.

The first question we asked was if, in fact, aeronautics was an industry near the end of its rapid technological progress, a sunset industry. We were determined to find out if the potential public benefits justified the cost of continued large Federal investment in R&D.

This was the basic question of utility. If the answer was negative, then there would be little need to go on to the second question: How does the Government fit into aero R&T? Here, of course, we wanted to compare the Federal role in aeronautics with its role in other areas of science and technology.

The administration was applying rigorous tests of the utility of basic and applied research, development, and demonstration to other areas of national interest. We were determined to do no less for aeronautics.

The study resulted in a series of findings and of recommendations. Mr. Chairman, I will submit a copy of our summary report for the record, but I do want to discuss its major findings and recommendations with you now.

The group concludes that aeronautics as a technology remains extremely important in the United States. In national defense, the technical excellence of our aircraft provides an important margin of superiority over the Soviet Union.

Aeronautics is involved, one way or another, in about one-third of the defense budget. In the civil sector, aircraft are now the dominant common carrier for intercity travel, and the safety and control of that travel are a Federal responsibility.

In looking at the industry itself, we paid attention to the strategic needs for aircraft manufacturing capacity. Although these are substantially met by ongoing defense procurements, we recognized the national security value of the additional capacity of a healthy and competitive civil aircraft industry.

The fact that our civil industry provides very strong positive balance of trade for the United States is important. While we expected the private sector to be prepared to support the necessary R&D to maintain that strength, we certainly wanted to be careful that we didn't disrupt a strong industry by an arbitrary change in Government policy.

In fact, the U.S. civil industry is strongly challenged today and will continue to be. Some of this is a result of worldwide economic conditions, international trade policies, and foreign government financing arrangements. But we also came to the conclusion that a competitive U.S. industry draws on and will continue to draw on advanced technologies from both the public and private sector.

By far the most significant finding to emerge from our study concerned aeronautical research and technology itself. It is clear that returns on aeronautics research are not diminishing. Let me give a few examples of what benefits we can expect in coming years.

In general, markedly greater carrying capacity and fuel efficiency for fixed wing aircraft. That means greater operating efficiency vital to civil operations, and it means rapid, long-range deployment of larger payloads for military transports.

Fighting aircraft can be smaller, more reliable, and cost less to operate. They can also be more versatile, operating from smaller runways and having greater penetration capability. Rotorcraft will go farther and faster; they will be more readily deployable. Cruise missiles and pilotless aircraft can be similarly improved. In all cases these changes can be substantial, ranging up to 100 percent improvements over today.

I call these findings the most significant because they demonstrated conclusively that aero R&T remains a solid investment. The potential for technology advances in aeronautics shows it is clearly not a sunset industry, at least not because of any technological limitations.

This also means that aeronautics R&T continues to have immense strategic value, both for defense needs and for the economic benefits to the Nation from a health civil aviation manufacturing industry. This strategic potential, particularly for national defense, demands continued Government activity in aero R&T.

To a large extent, military and civil aviation development share a common R&T base. Except at the extremes, we find it difficult—and pointless—to separate two distinct strands of research. This means that there is an inevitable spillover of usable research to the civil aircraft industry from ongoing military programs.

The dual nature of aeronautical research, combined with business pressures for high and early return on investment, this creates a general concentration of company funds on R&T with near-term payoffs. But we also confirmed that it is very difficult for companies to justify investment in longer term aeronautical research because they can't capture the benefits for themselves.

As a consequence, we see no alternative but continued Government support if we expect to maintain the level of research and technology demanded by national interests.

These findings—on the importance of aeronautics, on the nature of the aeronautics industry, and on aeronautical research and technology—then set the stage for a series of recommendations made by the study group. These recommendations fall into five categories. Again, they are detailed in the report, and I will only summarize them for you now.

In general, national interests dictate that we maintain an adequate aeronautics research and technology base for development of future aircraft and for an effective air transportation system. We must also create a domestic climate that will enable U.S. companies to compete effectively with foreign industry.

Overall, the Federal Government should assume responsibility in two general areas.

One is support of aero R&T development. These activities, which run from basic research through validation of design procedures, are characterized by a large degree of uncertainty in outcome, but they underlie all new aircraft and systems development.

The second area is demonstration of technologies for military applications. This is the final activity before actual system development and provides the basis for decisions on final design.

To a large extent these findings and recommendations affirm many of the practices and policies that have guided aeronautics in recent years. Perhaps this isn't a surprising conclusion, but it was by no means preordained when the study begain. However, there are some specific recommendations for changes that I would like to describe.

The delicate balances that have evolved among Government agencies are important to the exchange of research results and the stimulation of new ideas. We don't propose to change that balance, but we do want to spell out more clearly what the relative roles are.

The Department of Defense would be responsible for technology development and demonstration programs directed specifically toward military applications. NASA would be responsible for research and technology development programs, and it will assist the DOD's military technology demonstration programs. The Federal Aviation Administration would continue to be responsible for air traffic safety and safety-related research and technology.

We are also concerned about the uncontrolled dissemination of unclassified U.S. aeronautics R&T data to foreign parties and our own weak performance in collecting and disseminating unclassified technical information from both domestic and foreign research.

There are two major consequences: (1) We prevent our aerospace industries, which are being strongly challenged in civil markets, from capturing the full benefits of our own Government research. (2) We fail to keep fully abreast of the large amount of aero research being conducted by other countries with strong R&T programs themselves.

So, we strongly recommend that both NASA and DOD, in conjunction with other organizations, improve the dissemination and control of research results between them and, particularly, U.S. industry.

We also recommend that NASA come up with a plan for collecting, evaluating and disseminating all kinds of unclassified aeronautical R&T research results.

We want to see another step taken to improve the general coordination of aero activities. The old NACA Advisory Board served a useful purpose in bringing the various Government and industry interests together periodically.

In the 25 years since NACA's elimination, that mechanism has been increasingly missed, so we recommend the reinstitution of a high-level NASA/DOD/industry committee that would meet at least once a year to review all aero R&T policies. Such a committee would be able to provide useful guidance to operating agencies, to the White House, and to the Congress.

Finally, our study concluded that given present plans we don't need to add any new major experimental facilities now. However, we do need to modernize existing ones. We believe NASA and DOD should develop a coordinated operating plan so decisions about which facility to use can be based on optimal technical and economic criteria.

We also think a plan like this will then make it likely that needed maintenance and modernization programs will go ahead. In addition, the operating agencies could then expand the computational capabilities needed to increase the productivity and usefulness of test facilities.

These findings and recommendations, then, summarize the Report on Aeronautical Research and Technology Policy. Let me take the few minutes we have left to make some comments on the significance of this study and why it is likely to have important impacts on aeronautics in the United States in coming years.

As I already indicated, the result of our study was a general endorsement of the mechanisms for Federal support for aero R&T that have developed over the years. We also found that the balance that has been struck between Government and private sector funding is practical; that is, a responsible use of public funds.

In the end, we found that the policy for aeronautics R&D meshed extremely well with our overall Federal policy for R&D. I think this illustrates the highly pragmatic nature of this administration's support for science and technology.

After all, our goal is to meet national needs by investing Federal funds in R&D that pays off. Our twin criteria of excellence and relevance are clearly satisfied by continued Federal support of aeronautics research and technology.

One additional important point. As often happens, the difficult process of hammering out a policy has also produced a new determination among the participants to make it work. In the past, the lack of any stated policy created inefficiencies in establishing goals and in carrying them out. Now we have a clear consensus, a shared understanding of basic objectives and responsibilities.

Moreover, this consensus applies not only to the agencies, universities, and industries actively involved in R&D, but also to the policymaking and policy-implementing groups of Government.

I would especially single out OMB as a key participant in the process and one whose continued role will be central to the long-term stability we envision for aeronautics R&T. So even though the structure of aeronautics R&T may not change appreciably as a result of the study, we expect to see greater returns from our Federal investment because the programs will be conducted with greater efficiency.

It has now been nearly 70 years—going back to the establishment of NACA in 1915—since the Federal Government entered into this productive partnership with industry to advance aeronautics.

The relationship has held up remarkably well, evolving over the decades as the technology went from rudimentary to highly advanced. We now have a blueprint for continuing this partnership for many more years and for benefiting from those substantial advances that are yet to come.

Mr. Chairman, this concludes my formal statement. I would be pleased to respond to any questions.

Mr. GLICKMAN. Thank you, Dr. Reis.

First of all, let me ask you the base question. This report, which is summarized by this document I have in my hand, is it a fair statement to say that it has administration-wide agreement?

Mr. **Reis**. Yes, it is.

Mr. **Glickman**. So it is the statement of this President of the United States, then?

Mr. **Reis**. It is, indeed.

Mr. **Glickman**. You talk about the importance of the Office of Management and Budget. Is it possible that this report could be, let's say, undermined by OMB in an effort to curtail funds through the budget process?

Mr. **Reis**. We have an example of OMB's participation during the current budget process. This is the first one that was done under the aegis of this policy, and there was no attempt by OMB to undermine it. Having been through the budget debate last year without having a policy, I must report that it went a lot easier this year.

Mr. **Glickman**. What specifically are you talking about?

Mr. **Reis**. Well, I think the attitude. I don't think there was any question of the importance of aeronautics to this administration. That was not an issue. I believe there certainly is and will always be debate on particular programs. That will always happen. I think that is healthy that that happens.

There was a question, however, about aeronautics being a sunset industry, the Federal role in aeronautics, and NASA's role in aeronautics. All of these questions simply no longer were part of the debate.

Mr. **Glickman**. Are you aware as of yet what position OMB is going to take with respect to the funding of NASA's aeronautics programs in terms of the 1984 budget request?

Mr. **Reis**. I am aware of OMB's position, but I can't really describe that in any detail.The process is still going on; and until the budget is announced in January, I cannot describe any of the details.

Again, let me assure you that in my judgment OMB clearly went by the spirit of this document.

Mr. **Glickman**. So you have been through one of these budget hearings?

Mr. **Reis**. Indeed I have. We have been through the hearings. I am pleased at the result. I really do believe that the 1984 budget will reflect the policies expounded in this document.

Mr. **Glickman**. What followup steps do you plan or do you think we need to oversee the implementation of this policy?

Mr. **Reis**. There are several things that will have to happen. The first has to do with the attitude of the people involved. I think that has already changed quite a bit.

One of the things that we tried to do in formulating this policy was to bring together, directly, all of the people who were involved and have them engage in an intense, 7-month debate. They have learned an awful lot. That was the first thing that happened.

The second important thing in terms of implementing this policy is the high level review committee. There are, as you know, a number of coordinating committees between DOD and NASA and others. They provide a useful service in assuring that there is duplication of effort.

What concerned us was a question of policy implementation. We now have forward-looking enthusiastic and optimistic policy. It then becomes a question of having a group that will look at the forest and not worry about the trees.

Mr. GLICKMAN. So the difference between this NASA/DOD/industry committee as opposed to the current advisory committees would effectively be more of a management policy-oriented one?

Mr. REIS. That is correct.

Mr. GLICKMAN. You don't believe that any of the existing operations do that?

Mr. REIS. I don't see them doing that. I would suggest that if they were doing that, we wouldn't have had to go through this long, strenuous exercise. I think we built up some momentum for the aeronautics program, we have obtained high-level attention and we would like to see that continue.

The group felt the best way for that to happen was to have a high-level group at an appropriate level to oversee implementation.

Mr. GLICKMAN. Let me ask you this question. According to this policy statement, NASA's role includes aeronautical R&T development.

Mr. REIS. Yes.

Mr. GLICKMAN. Now, to help understand what this means, I am wondering whether you would consider, for example, the proof of concept flight test of the prop fan, the advanced propeller technology as that kind of activity.

Mr. REIS. I believe that would be considered to be that type of activity.

Mr. GLICKMAN. What about development and validation of the technology base for a civil supersonic transport?

Mr. REIS. I think that is another example of something that clearly would be considered feasible under this policy. It is really a question of judgment. There is no hard line drawn that says to NASA, you cannot go over this line. There is always a question of judgment on those types of activities.

Mr. GLICKMAN. I am glad to hear you say that. I am not necessarily saying we need to go with supersonic technology, but I don't want it ruled out. That, in fact, has been an inhibiting factor in terms of—I feel—how NASA has been very stilted in terms of what kinds of activities they can pursue. For that reason there has been a tendency just to repeat the same kind of research activities every year.

Mr. REIS. I think that is a valid criticism and one that we shared and one that we tried to overcome. I really do think this is not an inhibiting document, it is an enabling document. That is why we put such stress in the beginning of the report about what the opportunities are.

What we found, much to my delight and to the delight of Dr. Keyworth and other people in the administration, is that aviation is the thing of the future, not just a thing of the past. There is really more to aviation than that found in the Air and Space Museum.

Mr. GLICKMAN. You talked a little bit about the fact that our data base is available to the rest of the world but theirs, whoever 'theirs' may be, is not available to us.

What practical steps can you think of, short of classifying everything, that we can take to reduce the dissemination of aeronautical research and technology data to foreign parties?

Mr. REIS. The first part of that question is the easy one. In terms of understanding what else is being done, NASA is producing a plan to put together a library, more than that, a center for translation and dissemination of foreign research and technology. That is the easy part.

The second part is a much more difficult question. We were not able to come up with an easy solution to the dissemination problem, so we asked NASA and DoD to work out that plan and report back on April 1.

There are some obvious things that you could do to insure that the United States gets the maximum opportunity to use this research. We are not talking about shutting anything off, but trying to insure that the American industry gets the first opportunity. For example, perhaps handling this material the same way that industry handles proprietary material.

They have been doing that for years. You don't need locks and vaults or a lot of extra red tape. We do think there are some practical steps to slow foreign dissemination down.

Mr. GLICKMAN. Again, I would hate to see us get into the classification business——

Mr. REIS. I agree with you.

Mr. GLICKMAN. When in fact what we ought to be doing is a better job in finding out what the rest of the world is doing, and if they in fact don't disclose those kinds of things, then we engage in a reciprocity type of situation.

Mr. REIS. The emphasis of the group was on that aspect of the problem, of trying to understand what is happening in foreign research, working completely.

Mr. GLICKMAN. What specific areas of aeronautical research and technology do you think need more attention and what specific ones do you think need less attention, if you can give that to us now.

Mr. REIS. That is a difficult question.

One of the things that we found was there wasn't any specific thing that was dominant.

An airplane is a very complex system. One of the interesting facts that emerged is that we are about to enter an ara where a lot of elements of the system will begin to act synergistically. Composites allow different aerodynamic configurations, different types of materials allow for better engines, and so forth.

Put together with avionics that allow you to fly unstable airplanes in turn permits different types of materials to be used, and so a new generation of air vehicle could be developed.

Thus, I didn't find any one thing; they all played together, as an aircraft, as a system.

Mr. GLICKMAN. By that statement you implicitly accept the necessity of the involvement of some systems development as opposed to just the pure, basic research because you are talking about the synergism of the way an airplane actually operates.

Mr. REIS. I think some systems development clearly will be necessary in time. Again, I think it is a judgment call as to when and where it is necessary. We simply will have to fly some elements.

Mr. GLICKMAN. You didn't speak at all to the issue of foreign competition directly except with respect to classification. What will it take to insure that the U.S. aeronautics industry is able to compete fairly in domestic and international markets?

Mr. REIS. I didn't discuss that on purpose. While the group discussed foreign competition in some detail, we did get background briefings on that area, I felt that it was inappropriate for us to deal with things like Ex-Im Bank procedures, tariffs, and those sorts of things.

We were mainly concerned with insuring that the R&D establishment we have is the foremost in the world. I believe that is most important. If we can keep our research first, I think we will be much better off.

So, as far as these other aspects you mentioned are concerned, I don't feel it would be appropriate to comment on them.

Mr. GLICKMAN. I am sure you have some personal feelings, but you don't want to make them for the record.

Mr. REIS. I am an R&D person, and I really would prefer not to get into discussion outside my field of expertise.

Mr. GLICKMAN. Here we are, we agree to lend the Government of Brazil over $1 billion to prevent their collapse and then we continue to have a very unequal trade policy with the Government of Brazil. You wonder what goes on in people's minds in this world.

I am not talking about pure reciprocity, but it does seem that some reciprocal arrangements would be good business practices.

Mr. REIS. You are not going to get me into that one.

Mr. GLICKMAN. OK, I won't.

NASA and DOD charge different rates in the use of their respective facilities. I am wondering if the difference between NASA and DOD, the way they charge—and I understand DOD actually ends up charging more than NASA in most respects—leads to noneconomic use of some facilities.

Did you look at that issue?

Mr. REIS. Yes, we did. Indeed, that was one of the areas we looked at specifically. We asked NASA and DOD to formulate a uniform pricing policy during the course of the study, but they couldn't quite do it. It is involved with more than just aeronautics but also includes the complete interaction of funding R&D between Federal agencies.

We asked NASA and DOD to come back by April 1 with a plan of handling the pricing issue.

Mr. GLICKMAN. Sometimes DOD will use a NASA facility because their own facilities are more expensive and they get a pretty sweet deal out of this. We discussed this when we discussed the Space Shuttle issue and how much DOD would deal with.

Mr. REIS. I am aware of that, too, sir.

Mr. GLICKMAN. I just want to make sure, and I am pleased to note, that you are working on that particular problem.

Mr. REIS. We are indeed. Again, we felt the appropriate way to handle this problem ask DOD was to NASA to come back with a plan. We recognized that very same problem.

Mr. GLICKMAN. Thank you very much for your testimony. I want to again compliment you for your role in putting together this report. I think it is quite productive and it realistically indicates that if we don't pursue something like the kind of thing you are talking about, then we are going to see our role in the world's aviation industry diminish much faster than maybe what is already occurring. What we obviously want to do is turn that around a bit.

You know the old expression, "What is past is prolog," and the fact of the matter is that you learn from experience in this world. Experience tells us the Government role in aeronautics has produced the strongest aviation industry in the world. While that history is changing rather dramatically, there is no reason why we can't continue to benefit by some of the good things that we have done as a government.

We thank you very much.

Mr. REIS. Thank you.

Mr. GLICKMAN. Our next witness is Mr. John Steiner, vice president of Boeing Co.

Jack, it is a pleasure to have you here. I understand there are some other representatives from other groups here, other companies, and they are invited up to the table to sit with you.

If you would identify them for the record, it would be helpful to us. As I said before, you may feel free to summarize as you deem appropriate.

STATEMENT OF JOHN E. STEINER, VICE PRESIDENT, CORPORATE PRODUCT DEVELOPMENT, THE BOEING CO., ACCOMPANIED BY RUSSELL H. HOPPS, VICE PRESIDENT AND GENERAL MANAGER, ENGINEERING AND DEVELOPMENT, LOCKHEED CALIFORNIA CO.; ROGER D. SCHAUFELE, VICE PRESIDENT, ENGINEERING, DOUGLAS AIRCRAFT CO.; JAMES J. KRAMER, GENERAL ELECTRIC CO.; AND J. WILLIAM WITHERSPOON, PRATT & WHITNEY CO.

Mr. STEINER. Mr. Chairman, members of the subcommittee, ladies and gentlemen, my name is John Edward Steiner. I am vice president of Corporate Product Development for the Boeing Co.

I am accompanied by industry colleagues, as you mentioned, Mr. Russell Hopps, vice president of the Lockheed Corp., at my far left; Mr. Roger Schaufele, vice president, Douglas Aircraft Co., at my left; Dr. James Kramer, General Electric Co., at my right; and Mr. J. William Witherspoon, of the Pratt & Whitney Co., at my far right.

One year ago, several of us were among the five industry representatives that provided testimony at the subcommittee's hearings on "The First 'A' in NASA." Collectively, our testimony issued a strong warning that the Nation's aeronautical prospects were in serious jeopardy if NASA aeronautics reductions continued in the face of surging research programs abroad.

We reminded the subcommittee that America's aviation success was founded on a sound and proven partnership between industry, NASA, DOD, and the universities, and that NASA research was the key linkage that made it all work effectively and efficiently. We also stated a substantial warning of the very serious economic and defense consequences implied with the continuing narrowing of NASA's independent role.

Since our last appearance much has happened. The many similar concerns expressed from both within and outside Government justified a hold position by the administration until a study to recheck the facts and issues could be conducted. This study, as we know, was chaired by the Office of Science and Technology policy.

I was one of the two private sector observers invited to sit with its steering group. It is appropriate today that I convey some observations of its conduct to the subcommittee. Afterwards, I will comment on some of the needs and problems that we see with respect to policy implementation.

First, I believe that the OSTP study stands as perhaps the most comprehensive effort made by our U.S. Government to understand just what makes U.S. aeronautics tick.

Furthermore, it probably was the most comprehensive effort ever made by our Government to assess the value of aeronautics, value in the sense of national returns to be gained from having a superior aeronautics capability.

Aircraft system superiority is key to the Nation's defense strategies and absolutely vital for our interests in negotiated arms reductions. Military and commercial aircraft account for over half of the 1.2 million jobs that the U.S. aerospace sector provides.

The industry's aircraft-related output in 1981 totaled nearly $35 billion and provided a positive trade balance of $13 billion, the largest of any industrial sector. Let me assure you that for some years now these aspects of U.S. aeronautics have been thoroughly understood by foreign governments.

Second, I observed that this was an "enlightened" study. Its principal discipline was to bring into frank and open debate, the normally compartmentalized views and knowledge as held by the many diverse Government offices having policy responsibilities affecting aviation.

I would like to also comment that they allowed me and my other colleague, Dr. Eugene Covert, to express our feelings with no constraints whatever.

All views were tested in heated debate and examined against private sector input. Some 22 industry companies were asked to provide additional insights and information. Active Government participation in the study teams included elements of the Department of Defense, NASA, the FAA, and the Department of Commerce.

Also included were White House offices such as the Council of Economic Advisers—which wasn't all that easy to deal with, but it was done fairly—OSTP, of course, and the Office of Management and Budget. I understand that study findings and recommendations were also reviewed and endorsed by the National Security Council and the Office of the U.S. Trade Representative.

While the policy summary document is relatively concise, it is backed by a wealth of substantiating data and information acquired from study team research and analysis. There can be little doubt of the credibility of the effort, and we must regard its conclusions with extreme seriousness.

The administration, and in particular Dr. Keyworth, Dr. Reis, and Dr. Montulli of OSTP are to be recognized for their leadership and the forthright presentation of recommendations, including the six national goals for future aviation activities. We in industry endorse these goals and the reaffirmation of a Government/industry/university partnership oriented toward their attainment.

The study properly concluded a high relationship exists between civil and military aeronautics. It confirmed that the technology base for both is essentially common and that contributions flow from both sides to maximize the benefits for the Nation. With few exceptions, aeronautical research cannot and should not be compartmentalized. These same conclusions were noted in the foreign examinations of aeronautics as well.

Each contributor in the U.S. situation has its special role and unique strengths. DOD, for example, tends to address research and technology that leads to the development of a previously identified military system. This is proper for specific system objectives, but the body of technology must be much broader if risks, even for specific systems, are to be minimized.

All four parts of the aeronautics research structure--NASA, DOD, industry, and academia—contribute to this broader research and technology base. Industry also must have a nearer term focus, one which allows product application paybacks on its research investments within a reasonable time period. Thus, both DOD and industry research tend to be somewhat constrained and the most independent of the four are NASA and the universities. The balance is vital.

Today the industry partner has another challenge which is absorbing quantities of money and further constraining its contribution to the broad R&T base. This is the challenge of manufacturing productivity.

Worldwide, industry is undergoing a computerized technology revolution affecting the entire development and manufacturing process. American productivity superiority is generally under challenge, and particularly in high volume mass production situations foreign builders have established productivity levels that are substantially ahead of the United States.

This has not yet happened in aircraft, but even here U.S. manufacturing leadership can slip unless our industry transitions effectively into a total integrated computer-based design and manufacturing process environment.

High investments in new computational tools and machinery are involved, and also the industrial retraining of thousands of engineers and manufacturing workers through several generations of rapidly advancing computer technologies.

By the way, I do not believe the magnitude of this industry investment is generally understood.

Manufacturing advancements, of course, are spearheaded by private sector industry investment, and the end result will be less expensive and higher quality military and civil products.

Maintaining aircraft manufacturing superiority is vital to the aeronautics goals of this Nation. Civil competitiveness, military acquisition costs and defense surge capabilities are all involved.

For reasons of the latter two, DOD has raised its support priorities in manufacturing technology programs. Nonetheless, it is a costly job for industry, which makes the aeronautics research and technology role of NASA and DOD even more important to the overall attainment of the Nation's aviation goals.

Last year we testified that aeronautic potentials were far from reaching their maturity. The OSTP study has also affirmed this position, noting that the identifiable improvements that can be made are very substantial, ranging up to 100 percent over today's aircraft, military or civil.

The combination of reduced structural weights, improved aerodynamic and propulsive efficiencies, advance flight control and flight management systems are among the many potentials which, for example, will provide very substantial operating efficiency payoffs for commercial aircraft.

Similarly, such efficiencies can mean military transports capable of larger payloads and longer ranges, or conversely much smaller and cheaper transports for the payload carried today.

Also on the military side, the same fundamental technological potentials can contribute to smaller and more reliable combat aircraft that are more versatile and less costly to operate. The military strategic aircraft will benefit in a like manner, with reductions in weight and size or increased trades in payload and range. Cruise missiles can also benefit.

These potentials offer vast opportunities for U.S. civil and military aviation. However, it is critical for us to keep in mind that high technology is a global opportunities game today and, as such, potentials on all fronts are open to discovery and exploitation by many foreign governments and their industries.

The policy recognizes this with respect to U.S. aeronautics. It notes substantial concerns for the continued uncontrolled flow of U.S. unclassified aeronautics R&T data abroad.

As a practical matter of American society, we believe that controls, while needed, cannot and should not form the major thrust of U.S. technology transfer solutions. We must also keep in mind that aeronautical history describes a two-way street, and many of the major pathfinder developments originate offshore. The capacity for exploitation has been the key, and the decade ahead will be critical in determining whether or not U.S. aviation will prevail.

We noted 1 year ago that from industry's perspective, aeronautical research and technology progresses through three distinct phases.

The first, basic research, must be maintained at a fairly continuous pace to produce the fundamental knowledge from which we recognize advancement potentials. Such knowledge is derived from hundreds of government, academic and industrial research and test facilities in many countries. It also constitutes the core research output from NASA.

The last is application of readied technology to an identified military or civil program. This is the technology exploitation phase and our American industrial system works very well here, providing that technological risks have been reduced to acceptable levels.

There are both military and civil program examples where this has not been the case, and either faulty assessment or knowledge of the risks lead to catastrophic program cost overruns and delays or to a less than satisfactory flight vehicle or system.

We must therefore focus on the critical middle ground for successful and timely exploitation to occur. The research and technology partnership in U.S. aeronautics becomes the most critical at this point since the readiness task cannot be effectively accomplished on a single thread basis that addresses requirements of either a specific military or civil program. It must instead be achieved through multiple technology programs cooperatively orchestrated to get each piece of the technology into a state of readiness where it can be used.

As noted earlier, it is generally not feasible to make distinctions at this point between civil or military applications. There were at least five specific areas where such work is considered inadequate as it is now proceeding in the United States. These are advanced structures, full-scale active controls, fly-by-wire and all-electric airplane, propulsion systems, and aeroconfiguration development.

All will require extensive study and development effort over this next decade. All may require consideration of flight research programs using existing aircraft, with appropriate modifications, as research vehicles.

While not prototypes for future aircraft, such vehicles can be utilized effectively to understand the problems and risks in specific developments or integrations. Cooperative flight research is a particular strength shared by NASA and U.S. military aviation.

It will require more than a national policy or stated goals if this Nation is to retain its aeronautics superiority. Nonetheless, both are vital first steps before we can become serious about the problems of implementation.

Commenting on the road ahead, again, the new national "Aeronautical Research Policy" is an enlightened document. We in industry are gratified with recognition of the vital role that aeronautics has in our Nation's future, in defense capabilities and in jobs and exports benefiting the domestic economy. As noted earlier, we concur with the principal findings.

However, we also believe that congressional considerations with respect to implementation really reach far beyond the policy's subject of aeronautical research. The policy itself implies this. To an even greater extent, aircraft are becoming an increasingly visible part of the military and civil high technology fibers that are enmeshed in present-day world politics.

In this complex and difficult arena, national security implies more than a conventional arms balance. It implies a state of national economic security. For that matter, in many political minds the two have become one and the same, with high technology as the common denominator to exploit both.

Therefore, it should not be surprising that other world powers have planned and are implementing aeronautics policies aimed as part of their broad objectives for high technology growth. Aircraft have become a favored target area since they foster developments in so many related high technology fields.

One major concern, in view of this, is the fact that the United States tends to formulate its policies piecemeal and in terms of process; it sets the rules and then lets things turn out as they may. Implementation is process oriented as well, with audit tracks for the rules frequently overriding attention to results.

In other countries, similar policies have also been drawn and are in varying stages of implementation. The emphasis is on results, and if it is necessary to change the rules to achieve the desired outcome, the rules will be changed.

You have only to attempt sales of U.S. aircraft abroad to quickly see these differences. Exim financing and export controls are examples, and the OSTP study made note of the sizeable leverage that such nontechnical areas of policy can exert on aeronautics.

A second concern with respect to this policy's implementation is that of continuity. The United States has had great trouble executing a long-range plan that the policy's subject and findings would imply is needed.

Other countries, to a greater extent, tend to perform such planning and execute programs in a more consistent manner. In most cases this has little to do with democracy as the chosen form of government, and our problem with this appears to be more related to cultural or attitudinal aspects of U.S. society.

These two concerns I have voiced have a great deal to do with high technology in general and the aeronautics research policy in particular. In many ways this policy's implementation may well serve as a test of our determination and ability as a nation to survive, if not lead in a new and emerging world environment of high technology competition. It will most certainly test our ability to deal with the long-term aspects of this environment.

The comparatively slowed state of U.S. technological momentum has evidenced in major economic and security concerns that the Nation struggles with today. In the face of these problems, we must look to our national strengths for solutions.

Aeronautics is one such strength, and the administration has produced a thoughtful set of goals and a policy that addresses aeronautics in this task. We consider this to be one vital step toward solutions leading to a permanent recovery for the Nation and an American future that can and will continue to embrace vital high technology strengths.

However, the next steps, beyond policy, may well reveal our national determination to attain these objectives and remain a serious challenger in global high technology. We have a policy in hand. It is our sincere hope that by this time next year there is political consensus endorsing that policy and we are indeed on track and in time.

I would summarize with these points:

One, we need to proceed with continuity, with a steady and orderly rebuilding of the vital NASA, DOD and university research roles, along with industry. This must be done in a manner compatible with today's priorities and resource constraints and escalated as economic conditions improve.

Two, we need to proceed in an intelligent manner, one that exploits strengths unique to each of the aeronautical research partners in a cohesive and synergistic manner for efficient and timely attainment of the Nation's aeronautical goals.

Three, most of all, we need to proceed in an enlightened manner, with public and political awareness that this is a new world of global high technology competition. It is an environment with no guarantees whatsoever that the United States shall retain its leadership, in aeronautics or any other technological front, unless we work harder and demonstrate to the world that this Nation can run faster.

We are here to endorse the U.S. aeronautical research and technology policy and the goals it has established. It will require continuity in effort and high levels of national attention for these goals to be attained.

Thank you for the opportunity to express myself. I would now handle any questions you may have.

Mr. GLICKMAN. I want to thank you for an extraordinary statement. I know what role you played in this report. We have talked about it before.

There are a couple things in your statement that I think are important for the general economy. I would like to put them into a preamble of a national economic recovery plan.

You say.

> To an even greater extent, aircraft are becoming an increasingly visible part of military and civil high technology fibers that are enmeshed in present day world politics. In this complex and difficult arena, national security implies more than a conventional arms balance. It implies a state of national economic security. For that matter, in many political minds the two have become one and the same, with high technology as the common denominator to exploit both.

This insight is lost sometimes as we pursue national foreign policy, as well as domestic policy.

Then you talk about, on page 5, about high technology in general and aeronautics technology in particular.

> In many ways this policy's implementation may well serve as a test of our determination and ability as a nation to surive, if not lead in a new and emerging world environment of high technology competition.

The fact of the matter is that this is a model of what we can do in so many other areas to survive for the rest of this century in terms of all sorts of technologies. It is most refreshing to see that we have some form of reasonable agreement by industry and by government without necessarily sacrificing our free enterprise system, because I don't believe that your companies would endorse any major sacrifice of that system.

The fact of the matter is, you have presented an enlightened approach to how America can compete in the world in the next 20 and 30, and 40 years. Your industry has proved that you can have a cooperative approach with government.

I am glad at least to see what role you have had in insuring that this Government has recognized that a lot of the things which you are saying are true.

Mr. STEINER. Mr. Chairman, I would like to thank you for your compliments on the statement. Writing statements on policies which do get this broad is not an easy challenge. I would like to pay due credit to both the members of industry, representatives of which are seated at the table, and also to Louise Montle, who is in the audience, who refined the various inputs that we obtained to make a cohesive statement which is the statement you complimented, sir.

Mr. **Glickman**. Let me ask you a couple of specific questions. Does the industry support the OSTP recommendation for a permanent DOD/NASA/industry steering body addressing the long-term priorities in aeronautical research and technology?

Mr. **Steiner**. I would like to go from left to right and allow a very small amount of time, like half a minute apiece.

Mr. **Hopps**. The Lockheed Corp. enthusiastically supports the formation of a permanent aeronautics steering group. An expanded research and technology base, one that is guided and directed by such a group, comprised of NASA, DOD and industry, we feel could most certainly improve our defense posture through superior military aircraft and further enhance our economy through improved and favorable balance of trade.

We believe that such a permanent group is a mandatory element in order to provide continuity to a national aeronautics policy which really should be directed toward the next 15 to 20 years.

Mr. **Schaufele**. We enthusiastically support the OSTP recommendation. Such a steering group, composed of senior members of the aeronautics community, can provide a sharp focus for implementing the aeronautics R&T policy defined by OSTP.

Representation from all segments of aeronautics will assure that key technologies supporting all aspects of military and commercial aviation will be addressed and U.S. leadership in this vital area will be maintained.

Mr. **Steiner**. Leaving my Boeing hat on for a moment, I would concur with the recommendation of the policy. I think Dr. Reis stated the only concern I have, which is that it must be high enough in echelon to address priorities and still must not be so high that it is ineffectual.

I look forward to that challenge and hope that industry and even myself can further cooperate in making it happen.

Mr. **Kramer**. Mr. Chairman, I am Jim Kramer with the General Electric Co., speaking for the aircraft engine group.

I think the one particular concern of mine has been the interchange between the aeronautical research community within the Government, particularly that in NASA, and the private sector. I think rebuilding that communication link through a committee such as this would be a worthwhile side effect.

Thank you.

Mr. **Witherspoon**. I am Bill Witherspoon from Pratt & Whitney Aircraft.

Pratt & Whitney Aircraft fully endorses the proposal to form an aeronautics steering body of this type to evaluate and prioritize long-term research and technology. This body should review new long-term generic R&T base concepts which show promise of civil and/or military benefits for aircraft product requirements projected ahead 10 to 20 years.

Mr. **Glickman**. Thank you.

Let me ask just two more questions and then I will get to Mr. Carney, who was here first.

I might mention, Dr. Reis, Mr. Carney was not here for your testimony. He would like to have the opportunity to ask you a few questions. We go in at 11 this morning, so we will kind of be alternating the Chair. If you could stay for a minute, perhaps Mr. Harkin may want to ask you some questions, too.

It seems to me that perhaps this coordinating group would put a little more onus or burden on industry to maybe do a little better job, also, at defining those specific NASA programs that may be more required in terms of 15 or 20 years down the road.

One of the things that has struck me in the 2 years that I have chaired this subcommittee is that it is like any other business, it is human nature just to approve what we have done before.

Sometimes I wonder if the specific aeronautical programs within NASA that keep getting funded all the time, especially in the R&T base, may be there because they were just funded the last year and there is a constituency inside NASA for them.

I think it is really critical that given the role between government and industry that this document entails, that you have the obligation to try to let your views be more specifically known as to what NASA ought to be doing.

I guess what I am saying is I am going to talk to the NASA people about doing the same things as before, but I don't necessarily think we have to do it just because it was done last year if it is not getting us anywhere.

Mr. STEINER. Sir, you have touched on the most difficult part of the execution of the three-way steering body that is called a committee in the report. The reason it has to be of sufficient level is so that things can be cut off.

It is harder to cut off programs, sometimes, than it is to start programs. It takes judgment and also the ability to get access to the authorities involved to make that happen. I thoroughly concur with your comment, and I believe that industry is ready to collaborate with NASA and with DOD in assigning those priorities.

Mr. GLICKMAN. Let me ask you one final question, and this is off the subject a bit but I can't resist asking it.

This week we consider a bill which will basically limit the amount of foreign cars that can be sold in the United States. It is called the domestic content bill. Among the groups in opposing this bill are the aerospace industries and your company in particular, Mr. Steiner, has indicated this to me.

This is not a set up question. You may agree with the aspects of this bill because we can't sell our airplanes very easily in some of the foreign markets in the world. I wonder—would you care to comment on the domestic content bill, how it might make the job of selling airplanes overseas any easier, harder, anything like this?

Mr. STEINER. I doubt that I should comment on the bill directly since I am not familiar with its stipulations. I can, however, comment on protectionism in general.

The objective of technology, the objective of productivity, quality control and everything it entails is to run faster and have a better product at a lower cost. Price is related, and it is true that in some cases they don't have much to do with each other outside the United States.

I believe protectionism is the last resort as far as protecting our domestic markets through other than quality and insisting on let's say what we believe are relatively fair pricing versus costing policies.

I would oppose such protectionism. I would say that it will damage our ability to sell goods abroad. As you know, the commercial airplane market is very dependent for success of a manufacturer on foreign content for two reasons. One is continuity, due to the swings in the U.S. market, wild swings in the historical past; and the other is volume. We are very dependent—60 percent of our product is sold overseas. So, protectionist measures in general will decrease those sales and lose those jobs.

Other than those remarks, I think comments on the actual bill itself go beyond my capabilities.

Mr. **Glickman**. It was probably an unfair question, but I think that the two interrelate. The major opposition to that kind of legislation comes from our two leading export industries, aviation and agriculture. I wanted to just get some words from you on that.

Mr. Carney, do you have any questions?

Mr. **Carney**. Thank you, Mr. Chairman.

I apologize. My flight down from New York was delayed because of landing slots at Washington. I apologize for not being here and appreciate your consideration in allowing me to question all the witnesses.

Mr. Steiner, relating to the question of protectionism in a different sense, do you think we can do a better job of utilizing foreign technology while at the same time controlling our own research results so that foreign companies will not be able to take advantage of U.S.-sponsored research until we can take advantage of that research first, or at least on an equal level?

Mr. **Steiner**. Yes, I believe that can be done. I believe it takes a change in the thinking or possibly, I should say, in the culture. We must recognize that a great deal has been obtained for us from foreign sources. We must be willing to disseminate that in some orderly manner in a more, let's say, orderly manner than we have done in the past.

Conversely, we must be aware that technology has a time value. We must develop a cultural methodology. The reason I said culture is to avoid things like stamps and so forth, which tend to attract more than repel.

We must involve ourselves in let's say an educational process whereby R&T developments developed in the United States are made available to American firms faster. Remember, there is only a time value. He who wins runs faster. We must run faster and we must do all we can to extend that time balance. I do not believe we should erect barriers.

Mr. **Carney**. What you are saying then is with the technology transfer from R&D to applied work we just have to be in a position to get off the block faster than our competitors from overseas. The value is not timeless but time limited.

Mr. **Steiner**. Yes; but I also said that we should develop a culture that recognizes that we should not make unclassified data available en masse to foreign manufacturers or foreign sources as fast as we make it available in the United States.

I specifically said we should do it in a cultural manner, not in a barrier manner. A barrier manner I don't believe will work. Furthermore, we have to have flow in the other direction.

Mr. CARNEY. Thank you.

Thank you, Mr. Chairman.

Mr. GLICKMAN. I want to thank you, Jack, and the rest of the gentlemen for participating today very much, for your role in getting this policy turned around, too.

Mr. STEINER. Thank you, sir.

Mr. GLICKMAN. Our next witness is Mr. Ed Stimpson, president of the General Aviation Manufacturers Association.

Ed has been a frequent contributor to this committee and a very relevant factor in my district as well.

It is a pleasure to have you here.

STATEMENT OF EDWARD W. STIMPSON, PRESIDENT, GENERAL AVIATION MANUFACTURERS ASSOCIATION

Mr. STIMPSON. Thank you, Mr. Chairman.

We do appreciate the opportunity to again be here this morning and to comment on the Aeronautical Research and Technology Policy statement which has just been released.

I would also like to compliment Jack Steiner and his panel and share your highly supportive remarks of Jack's very eloquent and thoughtfully laid out statement.

Overall, we think the White House statement is a most positive and constructive report. The conclusion that continued research in aeronautics is in the national interest is both refreshing and very commendable, because of the past attempts to deemphasize the Federal Government's role in aeronautical research.

Our association strongly supports the policy recommendations made in the report. In particular, we highly endorse the reestablishment of a Government industry committee to periodically review Federal policies and programs in aeronautics.

The old National Advisory Committee on Aeronautics is still looked upon as a highly successful mechanism for coordinating Government/industry efforts and establishing Federal policy.

In recent years we have seen a dimunition of this sort of cooperation, particularly with interpretations and actions taken regarding advisory committees to Federal agencies. In the area of general aviation, we have witnessed a highly effective and constructive mechanism become impotent over the last several years.

We also support the conclusions that a large common research base underlies both civil and military aeronautics technology. Emphasis should be on technology development readily adaptable to transport development, general aviation development, rotorcraft development, et cetera. For example, work on developing a data base and design criteria for composite structures is highly important to the entire aviation industry, not just a single segment.

We also support another principal conclusion of the report that the present sharing of responsibilities between Government agencies is basically sound. On the other hand, there are opportunities for leadership in specific areas. Later I cite examples where a lead agency needs to be designated with specific timetables for achieving results.

Frankly, we are disappointed that there was not greater recognition of general aviation in the policy report itself. General aviation's contribution to the national air transportation system is noticeable by its absence.

In the last analysis, actions will speak louder than words. This report will only be meaningful if backed up by definitive budget requests and programs.

In recent years, we have seen general aviation programs either highly curtailed or eliminated. In fact, we have strongly supported some of these actions when we have believed that they were either duplicative of industry efforts or nonproductive. On the other hand, we believe the time has come for a renewed R&T effort if the U.S. aviation industry is to remain in a competitive position.

Like many other segments of the economy, the U.S. general aviation industry has been severely impacted by the current economic recession. Through the first 10 months of this year, shipments are 55 percent lower and billings are 33 percent lower than for the first 10 months of 1981. This year, the industry will deliver less than 4,500 aircraft. In contrast, industry delivery levels were over 17,000 units just 4 years ago.

The U.S. industry is also facing major challenges from abroad. Recognizing the importance of the aviation industry to national and international economics, foreign governments have subsidized research and development, production and marketing, a situation not true in the United States.

The U.S. aviation industry is virtually the only private aircraft industry left in the world. In short, U.S. companies are competing against foreign governments.

We are pleased with some of the recommendations in the report regarding technology transfer. I think a lot more thought and consideration needs to be given to how we do this, in making some of this information more quickly available to our own U.S. companies, and at the same time establishing a two-way street because much valuable research is done abroad that we would also like to share in.

While U.S. manufacturers have been faced with prime rates of 20 percent in recent months, foreign governments have provided financing in the range of 8 to 10 percent. A 10-percent difference in financing charges for a $1 million airplane amounts to a substantial amount of money.

In the long-term, we are very optimistic about the worldwide growth of general aviation. The decentralization of industry, cutbacks caused by airline deregulation, improved and better products, and increased safety have all contributed to the demand for general aviation type transportation.

We are witnessing a pent-up demand for new aircraft. However, until the economy improves, including the profitability of our customers, we do not anticipate a significant improvement in the marketplace.

Just a few years ago the NASA budget for general aviation programs approximated $12 million. Today, it is about half that. We fully support the concept that NASA programs should advance technology development and be highly productive. Nonessential programs should be eliminated or curtailed.

Today, the basic NASA programs in aeronautics involving general aviation are in stall spin and natural laminer flow control. These programs enhance safety and increase the efficiency of aircraft, and only NASA has the facilities and manpower to do an effective job.

GAMA has submitted a report and recommendations to NASA and FAA for further research and regulatory action in the area of stall-spin aerodynamics. We highly recommend that additional emphasis be placed in this area and a definite timetable be established. This sort of recommendation we believe is entirely consistent with the White House policy statement.

In the propulsion area, we applaud NASA's effort to continue with the general aviation turbine engine program. This program in turbine engine technology will provide the improved fuel efficiency and environmental compatibility so necessary in the next decade. We would strongly urge that funding be provided in next year's budget.

In addition, we must increase the efforts in intermittent combustion engines. The technology for these engines must be developed now if we are to have them in place by the mid-1990's for the smaller class of aircraft unable to use turbine engines.

Efforts in ceramics, now directed at the automotive technology sector, must be accelerated and expanded to provide aeronautical technology for the year 2,000 and beyond.

As I mentioned earlier, composites also hold great promise for all segments of the industry, both military and civil. NASA's efforts in this area should be accelerated and strongly supported.

GAMA is also making recommendations to the FAA for a Government/industry research program in the area of crash restraint. Several years ago a NASA series of aircraft drop tests provided much new information about interior cabin structural deformations. Much more information is needed in this area, and we strongly recommend a new FAA/NASA/NTSB initiative in this area.

In summary, Mr. Chairman, we think this is a good report. Our only real concern is its lack of commitment to fund these programs. It recommends support consistent with overall Government priorities and the availability of funds.

Given the current austere budget climate, it is conceivable that many programs could go unfunded. We would urge, therefore, that the Congress insure that adequate funding is authorized and appropriated to maintain the viability of this Nation's R&T effort.

We appreciate the opportunity to comment and look forward to working with the committee on the implementation of the White House policy statement, as well as future NASA and FAA authorizations and budgets.

I will be pleased to answer any questions that you have.

Mr. **Glickman**. Thank you very much, Ed.

I notice on page 3 of your statement you indicate, "We are disappointed that there was not greater recognition of general aviation in the policy report itself. The absence of general aviation's contribution to the national air transportation system is noticeable by its absence."

Dr. Reis, when you come back, I would like you to address that.

I have been advised that there was no attempt—because I also noticed when I read through the summary that I didn't see anything about general aviation. I was later told that they were talking about aviation generically and they weren't trying to exclude.

I think your point is a good one to take care of for the record, Ed, so that nobody can read this report and believe that there was an attempt to exclude general aviation.

Mr. Stimpson. We had some concern in looking at the report. There were very few things, when you look at specific programs—and, of course, my testimony perhaps today talks too specifically to programs.

I think the report sets the broad framework under which many of these programs will be carried forward. We certainly should deal with all segments of aviation: Rotorcraft, general aviation, transport, and military.

I know in some of the early stages, at least, there was an awful lot of emphasis on the military involvement in the report and some less emphasis as to whether certain segments of the aviation community were really "in the public benefit."

Mr. Glickman. I am not sure, to be candid, that the reason why the administration changed their tune on the whole issue of aeronautics R&T was because of the military component in the whole picture. I suppose I shouldn't be all that terribly concerned as to why they changed their tune as long as the music is right.

Mr. Stimpson. I agree. I think the music has come out singing very well.

Mr. Glickman. I wonder—and you spoke about this a little bit—would GAMA support the OSTP recommendation for a permanent DOD/NASA/industry steering body addressing the long-term priorities in aeronautical research and technology?

Mr. Stimpson. Yes, we think that would be a positive, constructive step. I think, in addition to the larger steering committee, we also need more specific committees which look at some of the specific programs in some detail.

I mentioned in the advisory structure a few years ago we had an extremely effective committee, from our industry standpoint, working with NASA. That is not as effective today as it was 4 or 5 years ago.

I think, in addition to the broader steering committees, we also need the best industry input, as occurred a few years ago. It would be very easy to reinstitute this sort of top-level advice in the specific program area as well.

Mr. Glickman. Let me ask you one final question. I am going to put you a little bit on the spot, like I did Jack, about this domestic content bill because you and I have spent much time on the whole issue of trade policy.

The only reason I ask this is because that bill was reported to the floor without any significant hearings at all. I feel that I have a forum here and I might as well ask questions about it.

Do you think that the passage of legislation restricting basically the sale of Japanese or German cars in the United States will affect us in terms of our ability to sell airplanes overseas?

Mr. **Stimpson**. Basically we are a free trade industry still. As you know, we have supported free and fair trade policies because 25 to 30 percent of our aircraft are exported. Consequently, when you look at protectionistic measures, like the local content bill, I think we raise red flags.

We see danger signs going up because we would like to maintain the free trade environment. At the same time, I must say we shared our frustrations with unfair trade practices because we see them all the time around the world.

But basically I think the local content bill is just probably not the way to go because it will set off trade wars and, as a matter of principle, it is not sound public policy.

Mr. **Glickman**. OK.

Mr. Carney, do you have any questions of Mr. Stimpson?

Mr. **Carney**. Yes, I do

Mr. Stimpson, other than the generic type of technology development that the OSTP has endorsed, what do you see as the legitimate role for the Government in assisting GA?

Mr. **Stimpson**. I think it gets back again to the type of R&T which is beyond the capability of some of our companies to do. NASA has the facilities that we do not have. It has to do with the broader type work and aerodynamics, using their wind tunnels. Their R&T people are very fine experts in this area. It involves some of the broader programs like in the composites area, for example.

I think there is a role, and that is why it is so important that the government/industry committees and efforts be coordinated closely, because in the era of austerity of budgets and priorities and everything, programs should be really directed to those that will produce safety and fuel efficiency and help our foreign competitive position.

Mr. **Carney**. If I may ask—this question might be somewhat from left field—in your testimony you gave us an overview of the condition of the industry right now. Primarily you related that condition to the overall condition of our economy. You seem to be optimistic that if the economy turns around, that the industry will respond quickly. At least that is what I read into your testimony.

I have a question about the aircraft industry; that is, do you think that the aircraft industry itself has misread the requirements a little bit, and that, too, has an impact on the amount of American planes being purchased?

I have noticed that in a lot of the commuter aviation, for example, the American companies are relying upon foreign-built planes to meet that requirement. I perhaps should have asked this question of Boeing, because I used them as an example, where they were building the wide-body planes.

There seemed to be a turnaround in demand. The airline industry no longer wanted the large numbers of wide-body planes that it had 10 years earlier. It wanted smaller, more economical commuter types of aircraft. We might have missed that boat.

Do you think that this is a problem, and that this problem must be addressed before the industry will be back on its feet, even if the economy turns around tomorrow?

Mr. STIMPSON. Perhaps you are referring, Mr. Carney, to the fact that in the 30-passenger and above category of aircraft used primarily by the commuters there is really only one U.S. manufacturer involved, and that is Fairchild, in combination with Saab of Sweden.

There is a very legitimate question: Why is the U.S. industry not there with more 30-passenger airplanes, particularly as the commuter industry has expanded? I wish we had five or six 30-passenger U.S. airplanes out there that would be flying in the United States, as well as being sold abroad.

There are a variety of reasons for this.

One has been the fact that the U.S. manufacturers have been skeptical of the marketplace as far as the demand and the number of aircraft to make an economically viable and sound program.

Two, we have been trying to define these requirements, you might say. Our foreign competition has been ahead of us. Through their government support, R&D and marketing, et cetera, they are there, they have the airplanes, and they are here selling them today, both in their development aspects and their marketing aspect.

Even where we do have a competitive airplane, like in the 19-passenger airplane here in the United States now—we have a couple of models in the 15- to 19-passenger—we are facing foreign competition at 8 percent financing, 9 percent financing. Where we are competing in that area it is making it very difficult to sell against some of this foreign competition.

Mr. CARNEY. That is my point. Again—perhaps I should ask some of the other gentlemen as well; later on I will—it seems to me, as an outside observer, the aircraft manufacturing industry is going through something very similar to what the automobile manufacturing industry did about 10 or maybe 15 years ago.

When the automobile industry started to feel the effects of the small import, we didn't respond quickly enough. We continued to build the Cadillac and the gas guzzler. I hope no one from General Motors is here. I use that as a car that everybody recognizes as being rather big.

By the time we did recognize the fact that Americans have changed their buying habits, or were forced to change their buying habits because of fuel efficiency and economy, the foreign market had an edge on us in marketing, product development, in manufacturing development, and retooling.

I think, as a very uneducated outside observer, the aircraft industry might be going through the same thing.

Mr. STIMPSON. Let me try again. I think that is why we are all here today so emphatically making a plea that we do have a positive, constructive aeronautic R&T program because we do see the foreign competition, they are making good airplanes, and we need to keep ahead in our technology.

I think that is sort of the crux, that we want to stay ahead, and it needs a cooperative Government/industry effort to do it. I don't disagree with what your question is aimed at whatsoever.

Mr. CARNEY. My question was simply that when the economy turns around—and hopefully that will be very soon—the aircraft industry is not going to respond that quickly because it is not building the products that a lot of people will want.

Mr. STIMPSON. I am not sure I would reach that same conclusion. I think it is primarily the economy right now, but I think in the long range it certainly is our deep concern that we are building the products that our consumers need and want and that they are being built here instead of elsewhere.

Mr. GLICKMAN. I would just make the comment that it depends on what kind of airplane you are talking about. The people may be buying the air bus as opposed to the 767, not because of the quality of the airplane but because maybe the French will throw in a nuclear reactor if you buy a few of their airplanes.

There are all sorts of conditions out there that may interfere with just the normal consumer kind ofpicture.

Mr. CARNEY. Being a rather learned legislator I would never disagree with the Chair. I am not very learned in the aircraft industry. That is a point well taken, although the point that I was trying to make is, there is a requirement out there today that the American aircraft industry is not meeting, and that is the smaller commuter size plane. We see more and more purchases of it. I don't think it is going to take a man with a Ouija board to predict that those purchases will continue to increase.

Mr. STIMPSON. As we talked about earlier, it is primarily in the 30-passenger and above category.

Mr. CARNEY. I certainly appreciate the chairman bringing to the forefront the fact that we are in a very unfair competitive arena from abroad. I have had an opportunity to visit many of the foreign aircraft manufacturing plants, particularly in the smaller range, as well as seeing the consortium that builds the air bus and sells it with enough S&H green stamps and the right type of financing, that American companies really can't compete. That is something that we are going to have to address as well.

But there are two problems here: unfair competition and misreading the requirements of our market.

Mr. STIMPSON. That is true.

Mr. CARNEY. Thank you, Mr. Chairman.

Mr. GLICKMAN. Thank you very much, Mr. Stimpson. We appreciate your testimony.

Mr. STIMPSON. Thank you, Mr. Chairman.

Mr. GLICKMAN. Our next witness is Mr. Robert Ames, executive vice president, Aerospace, of Textron and chairman of the board of governors of the Aerospace Industries Association of America. You are accompanied by Mr. Robert Zincone, vice president, engineering, of Sikorsky Aircraft.

It is a pleasure to have you here, Mr. Ames. You may proceed as you wish. As I said before, you may feel free to summarize.

STATEMENT OF ROBERT S. AMES, EXECUTIVE VICE PRESIDENT, AEROSPACE, TEXTRON, INC., AND CHAIRMAN, BOARD OF GOVERNORS, AEROSPACE INDUSTRIES ASSOCIATION OF AMERICA, ACCOMPANIED BY ROBERT ZINCONE, VICE PRESIDENT, ENGINEERING, SIKORSKY AIRCRAFT

Mr. AMES. Thank you, Mr. Chairman.

It is very obvious that you and the Congressman from New York represent States that are heavily involved in aeronautics. You understand the importance of aeronautical exports. Your remarks certainly create an atmosphere that I have to describe as friendly and understanding and appreciative.

My name is Robert Ames. I am the current chairman of the board of governors of the Aerospace Industries Association of America, Inc., the AIA. It is the trade association representing the Nation's major manufacturers of aircraft, aircraft engines, helicopters, and related components and equipment. My company affiliation is with Textron as executive vice president of Aerospace, and that includes Bell Helicopter and Bell Aerospace.

Accompanying me is the distinguished vice president of engineering for Sikorsky, Robert Zincone. I will rely on him to amplify my remarks and answer any questions of a technical nature.

I might add that my comments have had the benefit of input from three other helicopter companies' vice presidents of engineering, Robert Lynn of Bell Helicopter, Kenneth Grina of Boeing Vertol, and William Brown of Hughes Helicopter.

I don't know if you realize what a remarkable thing it is to get agreement from four engineering vice presidents in the helicopter industry. It is almost unprecedented. They agree strongly with the conclusions of the report, they endorse those conclusions, and more importantly, they agree on their relevance to the helicopter industry.

On behalf of the AIA helicopter manufacturers, I am pleased to amplify our views on the recently released Office of Science and Technology Policy study on aeronautical research and technology policy.

First, it is clear that the rotorcraft segment of AIA does endorse the study group's summary report, even though that report doesn't place the emphasis that helicopter people would naturally like to see on the helicopter; but the needs and opportunities identified for rotorcraft in that report are realistic and challenging.

The study's emphasis on the airplane is understandable, as the helicopter industry is a relatively small segment of the aeronautical world. But the technical, military, and commercial challenges and potential associated with the helicopter are at least as great, and probably greater, than the other areas of aeronautics. To use the language of the report and of Dr. Reis, the returns on aeronautical research in the helicopter field are not diminishing at all.

The rotorcraft industry is a relatively young member of the aeronautics family, with the first production vehicles appearing in the early forties.

This requirement for vertical takeoff introduced technical problems in those early machines and they lagged behind fixed-wing aircraft by decades in aerodynamic and structural efficiency and flight control.

Significant progress has been made in rotorcraft technology since then, but it continues to lag behind fixed-wing technology in many respects simply because of the complexity of the physical laws associated with rotorcraft.

On the technical side, some aspects of rotorcraft technology are common to the airplane. However, there are a number of ways in which rotorcraft technology differ greatly in that it must address many unique, extremely complex and interrelated aerodynamic, dynamic, and structural design requirements. The unique elements of rotorcraft technology are relatively immature and the opportunities for continued progress are great.

The potential exists to develop helicopters that have significantly improved mission capability for both military and commercial vehicles. Increased range, productivity and speed are possible, as well as improvements in comfort, noise levels, life cycle cost, and safety.

Further, emerging technology supports the development of advanced rotorcraft that provide efficient high-speed performance that can be truly comparable to that of fixed-wing aircraft. The technical potential is great, but realization of this potential will require accelerated advancement of rotorcraft technology.

In my prepared notes I have commented on the helicopter's role in the military area. Let me just summarize by pointing out that of the 22,000 aircraft of all types in the Department of Defense inventory, 9,400, or 42 percent, are helicopters.

I think you are aware of the roles that these unusual machines have performed in major defense systems, such as tactical troop lift, logistics transport, reconnaissance, surveillance, and ASW in the Army and Marine Corps.

Without diminishing that role, I will summarize by pointing out that rotorcraft are a significant part of the aeronautical budget in the DOD. In the fiscal year 1982 budget, $2.2 billion will be spent to procure 213 helicopter systems. This will grow in fiscal year 1983 to $3.8 billion for 266 helicopter systems.

So, you see, helicopters are beginning to be a very significant part of the aerospace picture. National defense is truly dependent on the rotorcraft segment of the aerospace industry.

On the commercial side, the rotorcraft business has expanded at a compounded rate of 12½ percent over the past two decades solely on the basis of the unique capabilities of these machines. Rotorcraft do a job, they do a unique job, and that is why they have been purchased and that is why the business has grown.

You know about executive transport, airport taxi service, fire and police protection; the offshore oil industry can't exist without helicopters. They are all becoming important applications.

There are many expanding public service roles that are absolutely unique to the helicopter. These are among the reasons for increased government support of rotorcraft R&D.

Prior to the economic downturn, it had been projected that more than $25 billion worth of civil helicopters would be built during the next decade. In any event, as technology improves and provides better mission capability and lower cost operation, civil application will expand and the benefits to the public will continue to grow.

Now, a few comments on foreign competition. As is the case through all high technology industries—and make no mistake, aerospace is a targeted industry and the helicopter is a targeted industry product—U.S. helicopter manufacturers face a serious challenge from overseas.

On the military side, a recent State Department report on conventional arms transfer to Third World nations during the decade 1972-81 shows that the U.S. manufacturers' share declined from 52 percent in the first half of the decade to 10 percent in the second half. In the same period, the Soviet bloc share more than doubled and the Western European suppliers' share, with their increasaed thrusts in the Mideast and Latin America, remained nearly constant.

Commercially, the challenge from overseas competition is even more critical. The extent of the problem is evidenced by the trends in rotorcraft exports and imports. From 1973 to 1981, U.S. imports by units grew by a factor of about four. By contrast, units exported from the United States grew only about 6 percent.

Since 1980, the value of imports has nearly doubled, while exports have dropped nearly 30 percent, and the U.S. helicopter balance of trade has dropped more than 50 percent. This reduction in balance of trade is due in part to the new or modernized foreign rotorcraft that have appeared on the market, with development largely subsidized by foreign governments.

Although the OSTP study recognizes such threats to the U.S. aeronautics industry in general and notes the actions being taken by our Government to support our country's industry as a whole, the severity and consequences of the subsidized foreign manufacturers activities are not adequately highlighted. The problem is particularly critical for the helicopter segment.

The helicopter has been selected as a product for foreign government/industry teams whose goals are industrialization and maximized employment achieved through a single, designated, subsidized corporation.

These organizations enjoy the direct infusion of interest-free public capital awarded on a noncompetitive basis. They have the active assistance of their governments in both commercial and military marketing.

Having essentially no requirement for a return on their investment other than the employment of their citizenry, they can offer a continuing flow of new products, pricing and financing which cannot be matched by a U.S. company operating in our form of free enterprise.

As previously mentioned, you have to pick the right point in the market. We see in the helicopter industry models that have no place in the market. They are just there because there seems to be a desire on the part of the nationalized competitors to have a product that faces every American product, whether there is really a market there or not.

I want to emphasize that our foreign competition is both subsidized and often nationalized. I think in the words of one of our leading foreign competitors, these foreign companies, and I quote, ". . . each are in business for its nation."

There is no way that our companies can take that position. We are in business to produce a return for our shareholders and to show profits. We serve our Government, but we have to serve it in a manner that allows us to stay in business.

The shift in market share for the helicopter, as well as for transport and general aviation aircraft, is not simply a redistribution of the market to a more equitable ratio. It represents a primary threat to our high technology industrial base, with American jobs and a major part of our national defense capability hanging in the balance.

The helicopter manufacturers agree with the OSTP study on the nature of this problem, but we suggest that its consequences are far more serious for the well-being of our country than the summary report indicates.

Therefore, while we oppose adoption of a protectionist U.S. trade policy or any other unilateral actions by our Government which are inconsistent with internationally established trade rules, we must emphasize the urgent need for a long-range national policy for R&D, innovation and technology.

The development of such a national policy embracing national goals and the concept of an industry/Government partnership is critical to the solution of our economic problems and the future of the United States as a competitive actor in the world marketplace.

Mr. Chairman, I would like to address my remaining comments to specific aspects of the study report.

The helicopter manufacturers endorse the terminology used in the report to discuss the research and development process. The use of the phrases R&T development, technology demonstration, and system development accurately describe the activities and highlight their related risks and costs.

Additionally, because system development costs are so large in relation to other phases, this categorization is useful for focusing on the advanced effort that is so critical for our country's and industries' future.

We support the study recommendations on industry and Government goals in aeronautical and aeronautic R&D. Assuring that the U.S. industry can compete fairly with subsidized foreign manufacturers entails nullifying the advantage of the direct subsidy.

Incentives for both R&T and R&D seem to be in order. Tax incentives on R&D investment are suggested, or perhaps the elimination of disincentives. For example, why shouldn't military contracts carry the same full share of R&D as do commercial contracts?

As to the role of Government agencies discussed in this study, we particularly endorse NASA's role in conducting R&T development. Within the established fiscal structure, there is no possibility that private industry can perform the same function as NASA in this area. We would encourage the approval of increased NASA funding for aeronautical R&T for rotorcraft in particular.

Finally, the helicopter manufacturers endorse the recommendations of the study concerning facilities and technology transfer. We believe that the review of our procedures for disseminating aeronautical R&T documents will show that constraints are needed to assure that U.S. industries may first benefit from U.S.-sponsored research. That is particularly true in view of the subsidized commercial developments in other countries.

In conclusion, the rotorcraft segment of the aerospace industry finds the study group report on aeronautical research and technology policy supportive of the needs of national security and civil transportation and fully endorses the findings and recommendations stated.

I thank you for this opportunity to speak to you today on this very important matter. My colleague, Bob Zincone from Sikorsky, and I will now attempt to answer any questions you might have.

Mr. GLICKMAN. Thank you very much, Mr. Ames.

As I have said before, I believe that this report represents a fundamental policy change by this administration and perhaps the first formal statement of a business/industry/government cooperation in any major commercial industry, so to speak, in the United States.

I am not sure from reading your statement that you think that is enough. I just want to get that.

You talk a lot about the subsidization in the rest of the world, both in research as well as in production. Then you said, "Therefore, while we oppose adoption of a protectionist U.S. trade policy or any other unilateral trade rules, we must emphasize the urgent need for a long-range national policy for R&D innovation and technology."

What I guess I am asking you is that if we are not involved in the direct subsidy, shouldn't we be?

Mr. AMES. Let me restate a couple of things that might clarify, if you would. Perhaps if I could define what I call unfair competition by four points and then maybe mention two goals that we as an industry need. It fits, of course, to a degree into these studies that have been conducted and perhaps goes beyond them.

Let me define what I call unfair competition. First, it is the existence of a nationalized competitor with a publicized policy of creating a favorable export balance, if necessary, on a noneconomic basis.

Mr. GLICKMAN. OK, give me a specific. I know you don't want to give me names, so give me a hypothetical.

Mr. AMES. In the helicopter business—and Mr. Zincone, you may disagree or agree—it is clearly the French, the English, the Italians, and the Germans, the four major helicopter producers besides ourselves in this country and the free world.

The French are 100-percent nationalized and subsidized, and they get their deficits made up by going to the Chamber of Deputies. We would like to come to you to have our deficits made up, but I don't think you would like it.

Mr. GLICKMAN. We would like to come to you to have our deficits made up, I guess I would reply, but we can't do that unless you are doing good business and then we can get some tax revenues from you.

Mr. AMES. That is very true, and it brings me to the second point, that financial results are incompatible with the free enterprise system; in other words, the presence of subsidies or losses made up by a legislative process.

That is not true just of helicopters, remember. It is true of big aircraft. When we were at Farnborough, the United Kingdom Government announced proudly that they were applying $70 million to convert a Westland military ship into a commercial ship. That is just simply a grant to make a military ship into a commercial ship.

There is no question that in each of these countries there are different mechanisms to provide subsidies, but they always come back to some form of grant for a specific aircraft. That is very different from underlying aeronautical research, which I think all countries have found necessary to subsidize or sponsor in some way.

If I may continue with the third point in what I define as unfair competition, it is the existence of a balance sheet in which there are not normal loans at normal free market interest rates. It just chews you up to carry inventory and unsold aircraft today, but if you are a government and have unsold aircraft, that is the taxpayer's problem.

My fourth point—and this I think reflects the GAMA's views very strongly—is that financing which violates the spirit or letter of international agreements by, first, offering below market interest rates; second, offering excessive credits and grants as part of the financing package; or third, offering below market terms in exchange for an agreement by the buyer to purchase other goods produced in the seller's country, and you, Mr. Chairman, picked up that point.

I think there are two things that we as an industry can endorse. One is that we clearly want a significantly more vigorous export policy with emphasis on attainable goals, such as Eximbank revisions, making the GATT rules work, and really playing the game according to the rules.

Second, we need a significantly more vigorous R&D policy, again, with discrete goals in terms of tax policy, better IR&D allowability and, of course, supportive basic aeronautical research.

I think we really do believe as an industry that we can compete, but we do see that we have to play according to the rules on exports and we ought to match the rest of the world, where there are more liberalized rules for R&D.

All of that is getting a little away from this hearing but it all adds up to a very clear focus: You have to support basic aeronautical research.

Mr. GLICKMAN. I think that all of what you said is very relevant. What strikes me, where we have come down in America, is that for years we had leverage over the rest of the world, leverage for a lot of reasons: we were the strongest militarily, we produced the best products, we had the most R&D, we had all the natural resources.

I go back to what I said before: Here we guaranteed a loan for the Government of Brazil for over $1 billion to save them from bankruptcy and yet we still cannot sell our airplanes in Brazil in an open and free world.

It struck me, what happened to this leverage we used to have? Around here in this place, as you know in business, you ask somebody to help you on a vote, you try to help them out the next time.

My point is that we can't have that leverage, I don't think, unless we have a very adequate research and development base.

Otherwise we won't ever have the leverage. Once we have it we better use it once in a while or else be made to be fools.

Mr. **Ames**. I certainly concur with your remarks. We say as an industry, and we believe and I think Mr. Steiner made the point, that as long as we have advanced technology, a differentiated product, as long as we produce cheaply, and as long as we have quality, we are willing to play on those rules, but when pricing, either in the form of financing or simply price cutting, becomes the determinant of the sale, then the game has changed.

I think we are living in a world where the rules have been changed, and not particularly subtly. I think we have to stand for free trade and be willing to compete. I have never heard anyone in the aircraft industry say that we are not competitive, but that doesn't mean that you can make a sale if the competition is offering low-interest rates or virtually giving the aircraft away.

Mr. **Glickman**. Let me ask you one final question.

On page 6 you said, "For example, why shouldn't military contracts carry the same full share of R&D as do commercial contracts?" Can you explain to me what you mean by that?

Mr. **Ames**. Basically there is a ceiling. If you are a military contractor, there is a ceiling on the R&D that you negotiate with the Government. As a matter of practice, companies are really almost expected to exceed that ceiling. To the extent that they exceed the ceiling, those R&D costs are not absorbed the way other costs are absorbed. They are simply absorbed directly out of profit because they are not part of the labor hour that is spent on a Government contract. In other words, there is allowability up to a point.

When you sell a commercial airplane, every single commercial sales dollar carries its full share of the R&D. It has to be spread over something. So, the commercial aircraft always carries its R&D fully. The military sales dollar may not.

Mr. **Glickman**. Thank you.

Mr. Carney?

Mr. **Carney**. Mr. Ames, specifically, what type of research and development in rotorcraft technology do you believe NASA should be doing that they are not doing now?

Mr. **Ames**. I would like Bob Zincone, who is a chief engineer in this business and closer to the technical side than I am, to answer that.

Mr. **Carney**. Fine. No problem at all.

Mr. **Zincone**. First let me say that NASA has been and is continuing to do an excellent job in covering the very many disciplines that make up a helicopter. I just think NASA has to continue to penetrate vertically across the spectrum of the technologies that are involved in making a helicopter successful, addressing the intelligent application of composites, better aerodynamics, and getting the external noise of helicopters down.

There is no way that both the U.S. rotorcraft industry can expand commercially and internationally without getting the external noise of the helicopter lower so that it can become a favored citizen, so to speak, within the community.

There is a tremendous amount of investment going on internationally in Europe to get the noise of helicopters down. I am happy to say that very recently the four manufacturers and NASA for the very first time got together and created a program of limited resources, mind you, not very substantial, to try to address the noise issue.

That should probably take precedence with regard to investment because of the potential expansion of the commercial helicopter community, but it won't happen. Just like the problems we have in the fixed-wing community. We had to get the bypass fan engine to get the noise down. The noise sources on helicopters are far more complex and they tend to operate much closer to the communities, so that is a very, very critical arena.

One brandnew area that I know the Europeans will be moving into is the application of microelectronics for safety, through better onboard monitoring systems. It is a broad category that goes to aerodynamics, it goes to vibration, it goes to noise, it goes to handling qualities.

Helicopters are very complex, and yet they are at a point in their development of technology that one might say is a little above the DC-3. There are tremendous advances that can be made in range, in speed, in payload, and direct operating cost, and in safety. They all require an investment and those investments are being made by the competition.

Mind you, we all as individual companies are making that investment, but there is fundamental research that could be spread to all four of the manufacturers in the United States that NASA could embark upon, as well as supporting some advanced concepts.

There are some very revolutionary concepts that America is privy to that is not enjoyed by the rest of the world: tilt rotors, ABC's, and other concepts that can significantly increase the speed of vertical lifting machines.

There is an excellent opportunity for us to capture the world market for those kinds of vehicles with substantial investments, and those investments are not coming forward at the moment.

Mr. CARNEY. Thank you very much.

Mr. Chairman, those are all the questions I have.

Mr. GLICKMAN. Thank you very much, both of you, for coming down here today.

Mr. AMES. Thank you.

Mr. GLICKMAN. Our next witness is Mr. Norman Augustine, president-elect of the American Institute of Aeronautics & Astronautics and president of Martin-Marietta Denver Aerospace. Mr. Augustine is accompanied by Mr. H. Harvey Album, program manager of aeronautics for SRI, International.

It is a pleasure to have both of you gentlemen here. I note that your statement is quite lengthy. I would hope that you would be able to summarize it.

Mr. AUGUSTINE. Yes, Mr. Chairman, we would like to submit that detailed statement for the record, if we might, and provide a summary at the hearing this morning.

Mr. GLICKMAN. Feel free.

STATEMENTS OF NORMAN AUGUSTINE, PRESIDENT-ELECT, AMERICAN INSTITUTE OF AERONAUTICS & ASTRONAUTICS AND PRESIDENT, MARTIN-MARIETTA DENVER AEROSPACE, AND H. HARVEY ALBUM, PROGRAM MANAGER OF AERONAUTICS, SRI, INTERNATIONAL, AND CHAIRMAN, THE ADVISORY GROUP ON NATIONAL AERONAUTICS POLICY, AMERICAN INSTITUTE OF AERONAUTICS AND ASTRONAUTICS

Mr. AUGUSTINE. Mr. Chairman and members of the subcommittee, it is a privilege to appear before you this morning on behalf of the American Institute of Aeronautics & Astronautics. The AIAA is an organization of about 34,000 members, all of whom are professionally involved in the fields of aeronautics/astronautics.

We have had the occasion, of course, to testify before this subcommittee a number of times in the past, and we were honored this past year to have been asked by the subcommittee to convene an advisory group of leaders and experts in aeronautics to examine the NASA aeronautics program, and in particular the funding of that program.

We also were pleased later in the year to respond to a request by the White House Office of Science and Technology Policy to convene an advisory group from industry and academia to review and comment on the national aeronautics policy during the final stages of its preparation.

The written testimony statement that we provide for the complete record and additional testimony that we will present verbally this morning draw upon the consensus view of these advisory groups which we established. These Government advisory activities were directed by Mr. Album, who is my cowitness this morning.

It is the belief of the AIAA that aeronautics in this Nation is at a crossroads. We find historically that there have been perhaps two occasions, possibly even three in the past, where we have been at similar crossroads.

The first of those would probably be in about 1914 and 1915, and the national debate that occurred at that time led to the establishment of the National Advisory Committee for Aeronautics [NACA]. Again, in 1938 and 1939, we found ourselves at a major national decision point. At that time the NACA laboratories were greatly expanded and a number of aircraft development programs were initiated, which proved so vital in the effort during World War II.

Another debate, although not directly on the aeronautics program, took place in 1958 and 1959, when you recall there was considerable concern over the Nation's technology base, as sparked by the Soviet launch of the Sputnik. That particular debate led to the demise of NACA and the establishment of NASA.

The AIAA applauds the strong space program which has been pursued ever since that debate, but we deeply regret what we view as the subsequent diminishing of attention to the aeronautical R&D program in this country, both in industry and Government.

Today, we find ourselves at what I call another crossroads, a time when we believe it is necessary to re-establish an awareness of the impact of the aeronautics program on our Nation, the impact in the area of employment, the impact in the area of balanced trade, the impact on national defense, and indeed the impact on our national lifestyle, if you will, made possible by rapid, safe, relatively inexpensive transportation.

The effort to create a national aeronautics policy this past year has, in our view, been a classic example of the working of the democratic process. It has been an example wherein the Government, both the Congress, the administration, and its citizenry have worked together in a constructive debate.

All parties in the debate have had the opportunity to lay a number of wideley varying viewpoints on the table for consideration. A vital consensus has emerged from that debate, in a highly significant form, a national aeronautics policy.

I would now like to ask Harvey Album, the chairman of the AIAA's advisory group on national aeronautics policy, to briefly summarize the findings of his effort.

Mr. GLICKMAN. I am aware, Harvey, that you have done an analysis for this subcommittee before. I think you did it of the 1983 NASA budget. Not knowing what your workload is, we would hope that you would be able to do it for us again in the 1984 budget.

Mr. ALBUM. We intend to, if we are requested to.

Mr. GLICKMAN. OK. You will be requested.

Mr. ALBUM. Mr. Chairman, we cannot overstress our strong endorsement for the national aeronautics policy formulated by the White House. It is to the great credit of the President and the White House Office of Science and Technology Policy that this fusion of objectives has taken place and that we now have a national policy alined with similar strong, prevailing viewpoints expressed in Congress.

Your subcommittee, Mr. Chairman, I believe has been a leading force in bringing about this mandate to accelerate the Nation's progress in aeronautics. We believe that the new national aeronautics policy will become a milestone in this Nation's progress in aeronautics.

I would like to read the goals of the aeronautics policy. They are immensely important. Since no one has read them up to this point, I will introduce them.

The first national goal is to maintain a superior military aeronautical capability. It is very clearly stated: not an adequate capability, not a sufficient capability, but a superior capability.

The second goal is to maintain an environment in which civil aviation can flourish; not survive, not get along, but flourish.

The third is to insure that the U.S. aeronautical industry has access to and is able to compete fairly in domestic and international markets consistent with U.S. export policy.

The fourth is to provide for a safe and efficient use of the Nation's aerospace system, the vehicles operated within the system, and the facilities required for those operations.

These are the four main goals that came out of the policy review.

Policy is important, but it is only a start. The important thing now is to focus our attentions on the steps necessary to implement that policy.

Mr. Chairman, it is evident from developments over the last several years that our current force of actions and methods of operation are not adequate to fulfill our national aeronautics goals in the future. We must increase our investment in aeronautics and, at the same time, we must make every dollar count for more than it has in the past.

In our submitted statement we recommend that the Government take at least eight primary steps to achieve the stated national goals:

First, emphasize, upgrade, and integrate NASA's aeronautical R&T functions and activities by establishing a separate aeronautical management structure within NASA in the manner of the earlier NACA.

Second, substantially increase NASA's output of aeronautical research and technology.

Mr. Chairman, the current fiscal year 1983 budget for NASA, that is the total budget taking out inflation effects, actually stands, at the lowest level in a decade. We recommend that over the next several years, that the NASA budget be increased to a level of about $750 million in current value fiscal year 1983 dollars. This is the total budget, including manpower, facilities and contract R&D work. This funding level would equal to the average total NASA aeronautics budget for the 1979-80 time period, taking inflation into account.

This recommendation is, of course, contingent upon having viable, I would say vital, programs in that budget. The funding level should be either increased or decreased from that planning figure, depending upon what is actually in the program. That planning figure should be increased to account for inflation.

Third, the Government should provide financial incentives to stimulate private-sector investments in aeronautica R&D.

Fourth, the Government should provide adequate competitive financing through the Export-Import Bank to facilitate foreign sales of U.S. civil aviation products.

Fifth, the Government should emphasize the regular military development of austere, advanced, flying prototype aircraft systems.

Sixth, we should streamline the military aircraft and acquisition weapons procurement practices.

Seventh, the Government should institute a better process for determining military aircraft operational and design requirements.

Finally, the Government should increase support and stimulate industrial assistance for educating high-quality engineers and scientists to meet the future needs of American aeronautical R&D.

We have proposed actions here today that would improve our progress in both civil and military aeronautics because the national aeronautics policy deals with both sectors. This policy correctly points out the strong interrelationships and synergisms that exist between them.

Some of these initiatives require increased funding, and others call for better management methods that will increase our effectiveness, reduce costs, and increase our output.

In closing, Mr. Chairman, let me again stress our admirations for the fine workings of Government that we have witnessed both in Congress and the executive branch of Government on the issue of the national aeronautics policy. We appreciate having been consulted on this important debate and are gratified at its clear outcome.

Thank you.

[The prepared statement from Messrs. Augustine and Album follow:]

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Statement to

Subcommitee on Transportation, Aviation and Materials

Committee on Science and Technology

United States House of Representatives

on behalf of the

American Institute of Aeronautics and Astronautics

by

Norman R. Augustine
President-Elect

and

H. Harvey Album
Chairman, The Advisory Group on
National Aeronautics Policy

December 14, 1982

The American Institute of Aeronautics and Astronautics (AIAA) is a professional society of approximately 34,000 individual engineers, scientists, managers and students engaged in all disciplines associated with aeronautics and space. The AIAA has testified before your subcommittee on the National Aeronautics and Space Administration (NASA) budget and aeronautics over a number of years in the past. We were pleased to respond to your request last March to assist your subcommittee by convening a group of experts and leaders in aeronautics to provide advice to your staff on the relative priorities of technical program areas for the NASA aeronautics budget. The AIAA later testified on the importance of aeronautics and the same NASA budget recommendations at hearings before other Congressional committees.[1] We were gratified that the NASA budget was increased by approximately the amount we recommended. Later the White House Office of Science and Technology Policy similarly requested that the AIAA convene an advisory group from industry and the academic community to review the proposed national aeronautics policy during its final stages of preparation. We did this in late August. The Chairman of the National Aeronautics Policy Advisory Group formed by the AIAA for these activities was H. Harvey Album, Program Manager of Aeronautics at SRI International, who is also Chairman of our Technical Committee on Aircraft Design. He will present the primary testimony here today.

The AIAA National Aeronautics Policy Advisory Group was composed of various members of the AIAA Technical Committee on Aircraft Design, and the Chairmen or representatives of our Technical Committees on Air Transportations, Aircraft Operations, General Aviation and Management.

The members of the advisory group represented a wide range of different industrial organizations engaged in civil and military aeronautics and the academic community. There were no government members on the group in order to avoid potential conflicts of interest for them. The views that we will present are a consensus of judgments from the perspective of this particular group, whose members hold leading aeronautics positions in advanced design, aircraft requirements, development, air transportation, aircraft operations, management, and education. Any given point of view does not necessarily represent the individual opinion of every single member of the group or of each organization represented. I believe that you will probably receive a complete spectrum of opinions from other sources to consider. However, we were able to reach a high level of accord on the policies and related issues because of our common interest in advancing this nation's aeronautical capabilities.

IMPORTANCE OF AERONAUTICS

In my opinion, we have reached a major decision point in the course of aeronautical history in the United States. Twice before the U.S. Government has had such major debates and examinations of the importance of aeronautics to the nation, of the progress of U.S. aviation relative to that of foreign nations, and of appropriate U.S. Government actions. The first such case occurred during 1914-15 and resulted in the creation of the National Advisory Committee for Aeronautics (NACA).[2] The second such debate occurred in 1938-39, just prior to World War II, and led to a substantial expansion of both NACA laboratories and military aircraft development programs in industry. There was another major debate and turning point in 1958-59 that affected our rate of progress in aeronautics. This debate was on the space program. The result was the demise of the National Advisory Committee for Aeronautics, the creation of the National Aeronautics and Space Administration, and a general reduction in government emphasis on aeronautical R&D.

Over the last year, Congress and the White House have conducted another wide-ranging inquiry and debate on aeronautics in the United States. What has emerged again is a clear understanding of the unique role and importance of aeronautics to the economy, security, and welfare of the United States. The result is the subject of these hearings--the White House national aeronautics policy.[3]

AERONAUTICS POLICY

We strongly endorse the White House national aeronautics policy.[3] However, the important thing now is to translate this policy into actions. I will first discuss some general implications of the policy and then recommend eight major steps to achieve its stated national goals.

GOALS FOR AERONAUTICS

The White House Policy presents four clear national goals for aeronautics; they are that the United States will:

1. Maintain a superior military aeronautical capability.
2. Maintain an environment in which civil aviation can flourish.
3. Ensure that the U.S. aeronautical industry has access to and is able to compete fairly in domestic and international markets, consistent with U.S. export policy.
4. Provide for the safe and efficient use of the national airspace system, the vehicles operated within the system, and the facilities required for those operations.

It is evident from developments over the last several years that our current course of action and methods of operation are not adequate to fulfill the first three national aeronautics goals. Ample evidence of this fact has been presented in Congressional testimony, the White House study and in other studies. There must not only be increased emphasis on aeronautics to correct this situation, but, under current economic pressures, we must conduct these efforts as effectively and efficiently as possible. We must advance our pace in aeronautics and, at the same time, make every dollar count for more than it has in the past.

GOVERNMENT ROLES' IN AERONAUTICS

GENERAL GOVERNMENT ROLE

The White House policy study findings properly described the unique nature of aeronautics, which is our nation's highest technology industry.[1] Perhaps of greatest importance to this committee is the recognition in the policy study of the interrelationships and synergisms that exist between the civil and military segments of the aeronautics industry and the extent to which most research and much of the technology development are common to both segments. Even aircraft development programs or their derivatives--such as helicopters, light utility aircraft and some types of transports--can have both civil and military applications when properly designed. This means that the different agencies of government and the congressional committees that deal with military or civil aeronautics should consider the whole picture in formulating and evaluating proposed aeronautical R&D programs.

AGENCY ROLES

We agree with the agency roles outlined in the White House Policy. The most important thing is the relative emphasis that will be given to the various roles in the different agencies and the specific programs selected to implement the policy.

The White House policy does not, however, specifically mention a DoD role in conducting aeronautical research. The DoD currently conducts and contracts for both basic research (6.1) and applied research (6.2) to meet its needs. The fact that much of this work might also apply to civil aircraft should not preclude the DoD from using its own discretion in selecting research programs to ensure that its future research needs are fulfilled. NASA might well become the central government agency for basic and applied research in aeronautics. However, as noted in a National Research Council report last year "there has been an erosion of NASA's research capability..."[4]

In certain select cases, NASA should play an important role in advancing aeronautical technology development. However, there must be a particularly good fit between NASA's technology programs and those naturally undertaken by industry, the Department of Defense, FAA and other government agencies. The potential results of technology programs must warrant their costs in funds and manpower, costs which tend to be markedly higher than for basic and applied research. NASA's technology development programs must not displace or submerge NASA's creative, long-term aeronautical research, which we consider a high priority NASA function.

While we understand the definitions for the categories of work given in the White House policy, we recommend that the definitions be further subdivided for program planning and budgetary purposes. It seems important to break down the single term "research and technology development" into separate categories. For example: the categories might be (1) basic research, (2) applied research, and (3) technology development. Special package programs that span these categories might also be treated in duplicate program and budget reporting.

We endorse the White House's policy to establish a common government, industry, and university committee to review and coordinate aeronautical R&T policies. The government should expand its policies to cover all of aeronautics. There is a need for central coordination of aeronautics policies covering interface activities in civil and military R&D, trade, foreign relations, air transportation, finance, taxes and so forth. However, this central group should also evaluate steps needed to implement the policy and follow progress toward achieving the national aeronautics goals. In particular the committee should review the annual NASA aeronautics budget for appropriateness and adequacy.

The elimination of such a high-level aeronautical committee under the NACA did weaken high level aeronautical R&T policy coordination, as pointed out in the White House policy. However, the termination of the technical subcommittee structure under the NACA brought a greater loss in efficient interactive mechanisms at lower leadership levels including: joint evaluations of needs, joint technical advice, formulation of joint programs, program coordination, research reviews, and rapid transfer of technical information.

IMPLEMENTATING THE POLICY

The main focus now should shift from developing policy to actions necessary to implement the new policy. We recommend at least eight changes to achieve this nation's aeronautic goals:

1. Emphasize, upgrade, and integrate NASA's aeronautical R&T functions and activities by establishing a separate aeronautical management structure within NASA in the manner of the NACA.
2. Substantially increase NASA's output of aeronautical research and technology.
3. Provide financial incentives to stimulate private sector investments in aeronautical R&D.
4. Provide adequate competitive financing through the Export-Import Bank to facilitate foreign sales of U.S. civil aviation products.
5. Emphasize regular military development of austere, advanced, flying prototype systems.
6. Streamline the military aircraft and weapon procurement practices.
7. Institute a better process for determining military aircraft operational and design requirements.
8. Increase government support and stimulate industrial assistance for educating high-quality engineers and scientists to meet the future needs of American aeronautical R&D.

In our opinion the first six initiatives are equally crucial and the last two are extremely important for achieving our national aeronautics goals. All warrant the expected difficulty of instituting them. Some require increased funds. Others call for better management methods that will increase effectiveness, reduce costs or increase output. I will discuss these initiatives to an extent that seems commensurate with the purpose of these hearings.

1. AERONAUTICS IN NASA

We recommend that NASA emphasize and upgrade aeronautical research and technology, and treat it as a different, distinct, and equally important role relative to that of its space mission. NASA should consist of an aeronautics organization for R&T and a space organization. We recomend that the aeronautics part of NASA be organized in the manner of the earlier National Advisory Committee for Aeronautics (NACA). As an alternative, the committees of the new NACA might be established under the White House, as was earlier the case. However, the new NACA should directly interact with NASA's aeronautics organization in the same manner as did the earlier committees in the NACA. The new NACA should advocate, review, and approve NASA's aeronautical R&T programs and budgets. In any case, we recommend the formation of a National Advisory Committee for Aeronautics with its technical subcommittee structure consisting of representatives from all sectors of aeronautics. There should be a study to determine how this can best be done, one which defines the organizational structures to implement these recommendations.

NASA Organizational Structure--NASA is currently divided into four main operating organizations, all dealing with space activities. Each of these operating organizations is headed by an Associate Administrator. There is also an Associate Administrator for External Relations and one for Administration. NASA does not have an Associate Administrator specifically for aeronautics alone. Aeronautics falls under the Associate Administrator for Aeronautics and Space Technology. This office has four operating divisions headed by Directors: (1) the Aerospace Research Division, (2) the Aeronautical Systems Division, (3) the Space System Division and (4) the Energy Systems Division. The Aerospace Research Division deals with both aeronautics and space research. The Aeronautical Systems Division deals with aeronautical technology programs. Thus aeronautical R&T falls under two different divisions at the same level as energy programs.

Although NASA's complete budget for aeronautics is only about 8 percent of NASA's total budget, its mission in aeronautics R&T is unique and extremely important for the nation. As pointed out in a National Research Council report this year "NASA has been preoccupied with the Space Program and this mission continues today."[6] In our group's opinion aeronautical R&T deserves more emphasis and its own organizational structure on an equal level with NASA's space organization.

NASA's role in aeronautics is fundamentally different from its role in space. NASA conducts space research and advances space technology. However, NASA also designs, develops, produces and operates space vehicles. Except for its recent shuttle program support for the military and for customers with other payloads, NASA is largely independent in pursuing all aspects of its difficult space mission. There are no private or other government agencies engaged in such extensive similiar operations. On the other hand, in aeronautics, NASA provides a wide range of complex research and technology for use by a number of aeronautical manufacturers and other government agencies (civil and military). The resulting aircraft are bought and operated by a large number of organizations and even by private individuals. Hence, NASA does not conduct research and technology work for its own purposes in aeronautics and it is not its end user, as is largely the case for space. The situation is further complicated by the fact that aeronautical manufacturing companies, the FAA, and the DoD also conduct aeronautical R&T for their own purposes, but rely on NASA support for major portions of their long term research. Hence, for NASA to be most effective in aeronautics, it must be structured to interact differently with outside organizations than it does for space.

National Advisory Committee for Aeronautics--The earlier NACA was a uniquely successful government research, advisory, and coordinating agency for 43 years. This agency played a major role in making this nation the world leader in aviation during some very difficult times. The National Advisory Committee for Aeronautics was established March 3, 1915 by a two paragraph rider to the Naval Appropriations Act. A history of the NACA may be found in its annual reports from 1915 to 1958, and it is summarized in the 1959 final report.[2] The NACA was composed not only of its internal administrative and research staff and their facilities (like NASA), but also of the Committee itself with an extensive system of technical subcommittees. The subcommittees had representatives from all sectors of aeronautics. In 1958 there were 17 members on the Committee appointed by the President, with people such as:

James H. Doolittle, Vice President of Shell Oil
Edward V. Rickenbacker, Chairman of the Board Eastern Airlines
James T. Pyle, Administrator, Civil Aeronautics
Jerome C. Hunsaker, MIT
Thomas D. White, General, Chief of Staff to U.S. Air Force
Charles J. McCarthy, Chairman of the Board, Chance Vought Aircraft

In its final year, there were 23 subcommittees consisting of 500 experts and leaders from all segments of aeronautics who considered major problems in the various fields of aeronautics.

A past chairman of the NACA, Dr. Ames, gave the following primary reason for the success of the NACA: "The great success of the Committee [NACA]" is "because the committee is a success."[2] He described the functioning of NACA as follows:

"The organization has an Executive Committee which appoints a number of technical subcommittees whose function it is to coordinate research work throughout the country.... The various problems which all services of the Government and the people engaged in industry, so far as we know, have in mind are brought before the subcommittees. The importance of each problem is discussed and a program laid out....

"Around our table meet...representatives from all the Government services involved.... We work for all departments of government."

"Furthermore, there are discussions going on at our table between the Army and the Navy and all other people interested which otherwise would not take place. We are really a coordinating body and that function would be impossible if our organization were to be transferred to any executive department as such, because if our committee were to be a part of any department it would necessarily follow that the aeronautical needs of that department would be primarily served..."

"We think, therefore, that in our independent existence we offer a wonderful opportunity for serving all departments."[2]

The prime functions of the committee structure of the NACA were to:

1. Assist in considering problems related to their technical fields.
2. Review research in progress at NACA laboratories and other establishments.
3. Recommend new research to be undertaken.
4. Assist in coordinating research programs.

The subcommittees were a rapid and effective mechanism for assessing and communicating aeronautical R&T advances in the United States. The NACA performed a major national role in collecting, translating, and distributing technical literature on worldwide aeronautical research and technological advances. Many of these foreign advances were expanded through further NACA research. The NACA office of aeronautical intelligence was established in 1918 and functioned throughout the agency's history. As pointed out in a NACA annual report; "Promptly upon receipt, all reports are analyzed, classified and brought to the attention of subcommittees having cognizance and to the attention of other interested parties through the medium of public and private bulletins."[5]

A National Research Council report noted last year that "Following the creation of NASA in 1958 a sharp drop in aeronautics manpower occurred because of the agency important new responsibilities in the space effort. A full-blown and well funded space program resulted in a significant diversion of manpower and managerial attention and emphasis to this activity. Aeronautical research suffered in the United States as a consequence. Moreover, the NACA subcommittee structure, which had been functioning effectively, was abolished and a new organizational structure was created."[6]

Congress and the Executive Branch of Government have done much since 1967 to promote aeronautical R&T activities in NASA, but the all-important committee structure of the NACA has not been restored, and no similiar mechanism exists today in the United States. Outside advisory committees selected by NASA to review its aeronautics programs are by no means the same in terms of national impact. As pointed out in the National Research Council report, "NASA is a different organization than NACA. It is not governed by the committee structure, although it does continue to rely greatly on its advisory committees."[6]

The recommended establishment of a new National Advisory Committee for Aeronautics will provide advocacy, and increased emphasis for aeronautics. There will be an even better connection between NASA's aeronautics work and that of its recipients. The possible concern that this will lead to a focus only on near term work does not appear to be valid. The successful 43 year history of the NACA laboratories under many committees and subcommittees with changing membership implies otherwise. The fact is that all aeronautical organizations want NASA, in particular, to conduct systematic, innovative research as well as to spearhead certain major technological advances for long term applications.

Still, it would be beneficial to our national aeronautics posture if NASA would be called in more often, for short periods, in order to use its cummulative expertise to provide advice and assistance to industry in solving difficult development problems--as was the NACA. This is an important form of technology transfer. The National Research Council report appropriately noted that under NACA the "synergism of day-to-day in-house research and problem solving activity proved extremely effective. Each clearly benefited from the other."[6] This does not happen today to the extent that it did under the NACA structures and when the agency also had no R&T contracting responsibilities.

NASA's R&T contract program presents the only difficult feature in establishing a new National Aeronautics Advisory Committee to pass judgment on the NASA aeronautics budget and related programs. The members of these committees must be selected either to avoid or nullify potential conflicts of interest and undue influence in contract awards. We believe that it is possible to conceive a structure and a process that would avoid this problem.

2. NASA AERONAUTICAL RESEARCH AND TECHNOLOGY

The NASA should substantially increase its output of broad based research and also select innovative technology developments in order to achieve more rapid advances in American aeronautics. In our opinion, the current pace of advancements in U.S. aeronautics is not adequate to fulfill stated national aeronautics goals for the future. The White House policy study assigns NASA a special national role in conducting broad based aeronautical research and technology development. Certainly, the NASA aeronautics programs must be properly selected, funded, and executed in order to correctly carry out these functions. There must be good long-term planning, high quality people, excellent facilities, correct management, and consistent budgeting for the specific areas of effort.

Some general recommendations and observations about the NASA aeronautics budget seem inorder at this time. We recommend that the total NASA aeronautics budget be generally increased over the next several years to a level of about $750 million (FY 1983 constant dollars). This budget amount should be appropriately increased to correct for inflation. The total NASA FY 83 aeronautics budget of $553 million was the lowest level in over a decade, considering the effects of inflation. The NASA aeronautics budget is only roughly 8% of the total NASA budget, an amount which is not commensurate with the importance of NASA's role in aeronautics.

We are recommending that, as an initial planning estimate, the total NASA aeronautics budget be increased again over several years to about the average funding for FY 79 and FY 80, (in constant FY 83 dollars). This planning estimate should, of course, not preclude lowering or raising the actual budget based upon evaluations of NASA's aeronautics output, national needs and the merits of the actual programs submitted.

A significant portion of the NASA budget increases should be used to increase NASA's actual research staff, particularly by recruiting and hiring talented young engineers and scientists. The National Research Council report last year also noted as one of its major findings that there has been an erosion in NASA's aeronautical research manpower and a related decrease in research capability.[4] This report also stated; "The situation, if left unchecked, will surely have major ramifications.... It is essential that steps be taken to ensure that NASA research centers can attract and retain a well-trained research staff. This will require minor changes in the government's personnel policies and a closer cooperation with universities."

The White House policy study correctly points out the need to upgrade and modernize NASA's facilities. We agree that this is extremely important. It is equally important to provide increased operating funds for these facilities (particularly for the wind tunnels).[1]

3. AERONAUTICAL INDUSTRY R&D

We recommend the Government provide carefully structured incentives to induce investment of private capital in aeronautical R&D. American aeronautical product superiority is directly related to the total amount of industry and government R&D. As noted in the White House policy study, the civil aeronautics industry must take huge risks to develop new aircraft. Furthermore, the market is highly cyclical and often under great economic pressures, as at the current time. A single failure could drive a company out of business. We have witnessed such results in the recent withdrawal of Lockheed from the commercial transport business, a scaling back of new development work by Douglas, and, earlier, the withdrawal of General Dynamics Convair from civil transport development. No major American manufacturer is venturing forth into the light transport market (25-100 seats), except Fairchild, which has foreign assistance through a joint program. The most innovative U.S. general aviation aircraft development program, the Lear Fan, had to obtain foreign capital. Meanwhile, foreign industry aeronautical R&D is surging forward propelled by a wide assortment of government incentives and direct financial supports. The U.S. Government provides special incentives to other types of industries and investors where there is very high risk and a national need. The aeronautics industry clearly falls in this catagory.

The DoD directly funds aeronautical R&D done by industry for military systems, but increased incentives of a different kind are also needed here. The DoD does provide the military aeronautics industry with discretionary funds for certain types of Independent Research and

Development (IRAD). However, the defense system acquisition methods are still poorly suited to either evaluating or purchasing major innovative aircraft except where the government itself initiates and funds the program. There have been development programs primarily or totally funded by industry, such as the F-16E, F-15E, F-5G and the all weather A-10. Such aircraft may eventually be purchased, but these acquisitions do not fit the current mold for "requirements" driven, competitive, acquisitions.* The aircraft industry is even more reluctant to venture forth alone with its own funds for major military aircraft development programs, than is the case for civil aircraft.

4. COMPETITIVE FINANCING

We recommend that the Export-Import Bank provide additional competitive financing to facilitate foreign sales of U.S. civil aviation products.[7] In 1981, the United States exported $8.6 billion worth of civil aircraft and a total of $13.3 billion worth of all types of civil aircraft products. The Bank provided credits and guarantees that year for civil aircraft amounting to about 35% of that year's export sales level.[7] Financing of U.S. civil aviation products is a major factor in foreign sales, and availability of U.S. competitive financing through the Export-Import Bank is critical to maintaining and improving our foreign market share.

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*See later discussion on prototyping.

Financing by the Export-Import Bank has been a highly debated issue amid reports that the Bank's new policy is to reduce and withdraw from financing foreign aircraft sales.[8] Such a move would not be consistent with White House policy, which states that it is a national goal to "ensure that the U.S. aeronautical industry has access to and is able to compete fairly in domestic and international markets...."[3] Foreign aircraft manufacturers have a very wide assortment of supports for foreign sales--including low interest loans, graduated interest charges, and nothing down financing.[9] Whether or not foreign nations agree to restrictions on the rate of financing, they still have and are using other methods to offer equivalent reductions in ownership costs, such as reduced or free maintenance costs for several years, long periods of free training, and so forth. Also, some foreign governments offer support for sales expenses associated with opening new markets and package aircraft deals that also provide political, economic, military, and technological offsets. As pointed out in a 1981 Aerospace Industry Association report, once an airline begins to use an aircraft the manufacturer does not need to use as much leverage to sell additional units, derivatives and follow-on aircraft.[9] Then it becomes cost effective to keep the same line because of commonality in training, maintenance, logistics and so forth.

However, general aviation manufacturers in the U.S. see little of this assistance. The government has been doing a great deal to negotiating with foreign manufacturers to provide a fair competitive market. However, attacking only export financing may simply shift the area of emphasis to other forms of foreign government sales subsidies, at the same time eliminating the prime form of U.S. government export support available to our aviation industry.*

There must be a market for U.S. aircraft in order for the government investment in R&T to be meaningful. The users are, after all, the main reason for having a civil aircraft manufacturing industry. Hence, there is a clear need to develop implementation steps to achieve aeronautics goals associated with the health of the airline industry and other categories of civil aircraft operators. These segments of aeronautics fall under the national goals dealing with civil aeronautics and the U.S. air transportation systems.

5. MILITARY PROTOTYPES

The military services should emphasize the regular development of austere, advanced, flying prototype systems. We recommend that the military services budget an additional $150 million per year (constant FY 83 dollars), corrected for inflation, to initiate an average of three advanced military prototype aircraft each year. By prototypes we mean innovative experimental aircraft, technology demonstration and evaluation aircraft, or preproduction prototypes. These may be entirely new aircraft or major design modifications of existing aircraft. Many prototypes should be austere versions close to actual developmental aircraft or major aircraft derivatives of this category.

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*There are also tax incentives for exports in the U.S. and in most foreign nations.

The advantages of a regular prototype program, if properly pursued, will far exceed the costs. Specifically, prototype aircraft will:

- Provide aircraft options for future military acquisitions
- Allow sounder procurement decisions
- Provide focus for company and government laboratory technology programs
- Accelerate aeronautical technological advances and reduce development risks
- Yield new data on integrated designs--including engines
- Provide critically needed design and fabrication experience

The rate of new U.S. military aircraft starts has sunken to a all-time low. There were between 50 and 70 new military prototype aircraft (large and small) that entered flight-testing every five years from 1945 to 1960. We are not counting derivatives, full scale development versions of earlier prototypes or any aircraft modification programs. Table 1 shows that the number of new military aircraft entering flight testing dropped during the following five year periods to a recent rate of two per five years. These figures roughly reflect the declining state of progress in military aircraft.

Table 1

NUMBER OF ALL NEW AIRCRAFT ENTERING FLIGHT TESTING EVERY FIVE YEARS

Time Period	New Aircraft Every Five Years
1945-1960	50-70
1961-1965	23
1966-1970	12
1971-1975	13
1976-1980	2*
1981-1982	1*

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*These figures become 4 (1976-1980) and 2 (1981-1982) including major design derivatives.

The military aircraft industry cannot efficiently design and build reliable, highly advanced, new military aircraft when each of our companies has no more experience in developing complete aircraft than one aircraft every ten years. The existing stagnation in new experimental military aircraft is causing a fundamental erosion of our military aeronautical industrial capability.

Advanced aircraft prototype programs will provide a focus for expenditure of R&D funds by both company and government laboratories. However, the military services must set up proper mechanisms and incentives for channeling these efforts and funds into the prototype programs.

It is possible to develop prototypes, not only in austere design configurations, but also with a minimum of government administrative burden and excess costs.

The military acquisition process will have to be modified to provide the potential for properly evaluating, selecting and producing aircraft from prototype development programs. Otherwise, the activity will not fully benefit either the government or industry.

NASA has played an important role in certain past DoD experimental aircraft programs. The best match occurs when NASA concentrates on extracting basic knowledge from ground and flight tests, while the DoD and industry develop the aircraft, obtain performance data, and gain basic engineering experience. This applies the best talents, distributes the costs, and maximizes the benefits of the programs.

6. STREAMLINED MILITARY AIRCRAFT ACQUISITION

The Department of Defense should streamline its decision making process for the acquisition of new aircraft. The DoD is currently estimating lead times on a complete new military aircraft system at 10-12 years from concept to operational development.[10] The decision process is the biggest problem. Over the last two decades, the time it takes to study and decide on a new aircraft has increased from about 25% to 100% of the actual time required from the start of full scale development to operational deployment.[11] The actual development times have remained roughly the same for over 30 years. The decision making process and related chain of command seems to have grown unnecessarily long and complex. For example, the umbrella defense acquisition policy statement (DoD 500.1/.2) cited 15 policy documents in 1971, 26 in 1977 and 114 in 1980.[11] The process seems to be complicated by the structure of the decisions required, extensive justifications, the scope of the studies, and the difficulty of projecting needs far into the future.

Prototyping aircraft in austere first versions, with upgrade potential, is a way of making limited decisions for early starts. Austere prototypes can be initiated without commitment to full final development and production programs, until the hardware is in hand and flight results are known. The final decision can then be made closer to the time the aircraft will go into service. Thus the time and risks thus can be reduced by proper program planning. For example, the F-16 went from first concept through an austere prototype to first operational delivery in 7 years. The Air Force program office for the initial austere protype had only 8 people in it and the formal government reporting requirements were scant.

The military services absolutely must reduce the amount of costly unnecessary contract requirements and the growing complexity and cost of excessive reporting on data requirements. Our collective perception is that the force and direction of DoD procurement practices is growing more wildly divergent from the objectives of the procurements with each passing year. One aircraft company estimated in its input to the White House Policy study that somewhere between 25% to 40% of the government money spent on contracts is wasted on unnecessary contract interfaces.

Let us illustrate the growing complexity of paper work. The B-1B is the largest, most-powerful, military aircraft that has gone into development in over a decade. This aircraft weighs about 480,000 lbs and costs $160 million per aircraft. The government requires various tracking and reporting methods for its own uses on 210 data items under a fixed price contact having guarantees for this aircraft. Some of these data item requirements absorb the efforts of over 100 people working full time to accomplish and many require detailed subcontractor tracking as well. This might well be justified for the B-1B. However, let us now consider another aircraft, the Next Generation Trainer (NGT), which is the smallest, simplest, least-powerful, military aircraft to go into development in a decade. This tiny aircraft both weighs and costs approximately one percent of that of the B-1B. However, the contract for the NGT aircraft requires tracking only about of 15% less data items than the than for the B-1B. The percent increase in costs to the government must be very substantial. The NGT contract is reportedly also a fixed price "commercial type contract." Commercial contracts do not function this way. The military aeronautics industry has been issuing complaints about the unnecessary contract and paper work costs. These companies get paid for the work either way, but increases in aircraft price due to unnecessary paper work costs mean more risk of program cancelation and fewer aircraft to build and sell.

7. MILITARY AIRCRAFT OPERATIONAL AND DESIGN REQUIREMENTS

The military services should institute a better process for establishing aircraft operational and design requirements. The front end studies establish both the design approach and the requirements. The services should consider budget constraints during the course of these studies and evaluate the incremental costs of different operational and design requirements; in other words, "Require to cost". There is a much greater possibility of influencing the costs of an aircraft through its requirements than by the way it is designed.

Furthermore, the military services should increase the funding for the front-end design studies and testing. We have also noted an unhealthy decrease in government personnel available for these critical front end studies over the last decade. We are not calling here for generally more wide ranging or longer periods of studies, but rather for better front end starts for aircraft development programs. These studies should be limited to perhaps one or two years, followed by a decision on a prototype.

8. EDUCATION ASSISTANCE

The government should provide increased educational support to assure an adequate supply of highly qualified engineers and scientists for aeronautical R&D in the United States. It is just as important to produce enough good engineers and scientists to absorb, use, and expand on research and technology as it is to generate it. Fortunately, it is possible to accomplish both objectives with a single mechanism. Government research grants and contracts to universities have a multiple payoff; they provide:

- Aeronautical research results at low costs
- Financial support and interesting research work for teachers
- Financial support for graduate students and exposure to real problems
- Badly needed modern facilities for research and teaching

In addition, the government should provide financial incentives for the aeronautics industry to support universities through research grants and contracts--as well as donations of modern facilities.

There is a general problem in engineering education in the United States which has hit the fields required by the aeronautics industry. Engineering enrollments have risen about 90% in the last five years while the numbers of faculty have decreased about 15%.[12] The estimate is that 30% of the faculty positions will go unfilled by 1985 if the current trend continues. The number of PhD graduates has declined about 13% and about 40% of the PhD students are from foreign countries. In our opinion there is also a serious general shortage of modern and properly functioning aeronautics facilties for research and technology in many of our universities.

This nation will need greater numbers of highly trained engineers and scientists for aeronautical R&D in the future if we are to maintain our worldwide leadership position in this field.

CONCLUDING REMARKS

We have covered a number of initiatives necessary to achieve the goals outlined in the White House Aeronautics Policy paper. Some of these initiatives require major changes in the way the government conducts business and we do not expect such changes to come easily. The fact that some of these points may have been made by others before attests more to their validity rather than to our lack of originality. The opinions we have expressed here today basically reflect a consensus of the views of the National Policy Advisory Group convened by the AIAA.

We believe that the White House policy on aeronautics and these hearings will become a milestone in the history of aeronautics in the United States. Mr. Chairman, we thank you for the opportunity to testify here today.

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Mr. GLICKMAN. Thank you very much, both of you.

I would tell you, as I said before, and as was emphasized in Mr. Steiner's statement, that this document, if implemented, represents not only a model for continued growth and I use the word "dominance" of America in the aviation industry but may, just may represent some form of a model for America's regrowth in all major industries in this country because the aeronautics industry, to a large extent because of people like yourself, the technicians of the industry, has found a way to cooperate with Government.

We were worried for a while that trend may be changing. This document seems to indicate it is not, that without this kind of cooperative role we are going to be pushed to the bottom in terms of the American aviation business.

I am appreciative of your testimony. I would like to ask you one question.

Inasmuch as you represent people who basically are in the front trenches of insuring that we produce the best airplanes in the world, the question of how we deal with aeronautics data and information that we may get as a result of NASA research that gets out to the rest of the world, what practical steps might be taken short of classifying everything to reduce dissemination of research data to foreign parties? Is there any way to do this without getting some sort of reciprocal arrangement?

Mr. ALBUM. I would like to give you my personal opinion on that, if I may, rather than speaking for the institute, since our advisory groups have not yet addressed this issue in sufficient detail.

Mr. GLICKMAN. You answer any way you want to.

Mr. ALBUM. I believe that the information transfer problem is a two-way street. I think you mentioned earlier some points along that line. One is we have got to do a better job of processing information in the aeronautics area that is available to us from foreign nations.

Mr. GLICKMAN. We were told that that is in fact a part of this report. We are going to have an effort to try to gather that information.

Mr. ALBUM. We strongly endorse that.

The other part, the outflow part, is of course a much more difficult problem. I think the answer in the nonclassified areas of literature, the sort of thing that NASA produces and so forth that is not classified, is a matter of treating it in bulk; in other words, you try to cut down the bulk outflows of information. The objective should be to trade information where you can.

For example, at the current time I understand that the Soviet Union has a standing order for everything that is put out by the U.S. National Technical Information Service. We are talking here about the results of billions of dollars worth of U.S. technical work and not just in aeronautics. Now, do we get the same things back? Just for the cost of printing and handling the document, a $7 or $15, they and other nations can easily get the results of perhaps $100,000, $200,000 or more worth of U.S. research and technology. I think that sort of thing has to be addressed.

Mr. GLICKMAN. Let me ask you, when you say put it out in bulk, you mean don't piecemeal it out and then——

Mr. ALBUM. They can buy it just for the cost of the document rather than having it traded in some way. Some people say that the Soviet Union or any foreign nation can get it through third parties. Well, make them do it the hard way, unless you are trading it. We do trade journals and things like that. We should expand these activities, particularly with friendly nations.

It is a matter, on a governmental basis, of treating things in bulk, when you get down to trying to get to each individual document and determine whether that is exportable or not exportable, then you run into real trouble and you have to start going through classifications and things like that. I am not prepared to say where that line should be drawn.

Mr. GLICKMAN. It is a murky area, but I suppose that the biggest worry that I have had over the years is we may have nothing to trade any more in information, in which case if we have nothing to trade, then we have no leverage at all over the type of information that we might want to withhold. That is a great fear.

Mr. ALBUM. I think it is important for us to remember that many of the advances in aeronautics in the United States have come from foreign nations initially. For example, the aft-swept wing was originally a German theoretical work. Even the skewed wing, which is being worked on now, was originally a German theoretical work.

We have winglets but forms of end plates and early research along that line was done in a multitude of nations. We have had slats and flaps and almost anything you can mention, much of the work was done here and some was done abroad. So we have to be very careful not to cut off those kinds of flows by absolutely limiting access to our technical in formation.

Mr. GLICKMAN. Mr. Augustine, you had a comment?

Mr. AUGUSTINE. Yes. I would just add to that that I think it is fruitful to consider the types of technical information transfer in two categories.

One is that of basic research, fundamental physical phenomena and such. That area of research thrives on open communication and exchange of challenging ideas.

The other area is the application or the engineering of those ideas into products. I would think we would be well-served in the former area of basic research to be more open in our exchanges and to place our controls more on the application.

Mr. GLICKMAN. Mr. Carney, if you have no questions, we thank you, gentlemen, for coming here today. We are very appreciative of your help.

Mr. AUGUSTINE. Thank you very much.

Mr. GLICKMAN. I am very appreciative of Mr. Album's help on analyzing the NASA budget. As I said before, we have to be careful even when in our desire to expand the Federal role of aeronautics that we just don't approve NASA programs just because they were approved in the year before. There has to be some relevance to what is happening in this world, even in the area of basic research. I know that you have helped us in that area, and I am appreciative.

Mr. **Glickman**. Our last witness today, in a sense saving our best for last, is Gen. Bernard A. Schriever, who is the former Commander of the Air Force Systems Command.

It is my understanding—in fact, I know this, it is not my understanding—it is a well-known fact that General Schriever is a pioneer in the aviation and space business. He headed the Air Force effort in the 1950's to develop the intercontinental ballistic missile. Later he headed the Air Force Systems Command, which has responsibility for all air research and development.

He accepted our invitation on short notice when retired Gen. Kelly Burke could not come. We have asked you here, General, to comment on the statement from the Office of Science and Technology Policy from a military standpoint, as well as anything else that you may feel is pertinent and relevant to the issue of aeronautical research and development.

It is a pleasure to have you here today.

STATEMENT OF GEN. BERNARD A. SCHRIEVER, U.S. AIR FORCE (RETIRED), FORMER COMMANDER, AIR FORCE SYSTEMS COMMAND

General **Schriever**. Thank you, Mr. Chairman.

It was on rather short notice, so therefore I have no formal statement. I don't have all my aides and my staff anymore, so I have to carry my bags through airports and I have to prepare my own research and my own comments, so you can understand why——

Mr. **Carney**. Welcome to the club.

General **Schriever**. I have been in it for quite a while now.

Mr. **Carney**. Retiring from the Army or the Air Force as a General is like being in the minority in this Congress. [Laughter.]

General **Schriever**. First of all, let me say that I have read all of the statements that have been presented by the other witnesses. Practically everything has been said concerning the policy that needs to be said.

I happen to agree. I think that the policy is something that is extremely timely. It is excellent, is very badly needed, and in many ways vindicates some of my concerns over the past 20 years. We have been going downhill I think pretty badly with respect to aeronautical research and technology.

My comments will bear pretty much on specifics to add a little emphasis.

What the policy now needs is implementation. Here I agree very wholeheartedly with what was just read in these eight points that are contained in Dr. Augustine's prepared statement. I would like to refer to what I consider specifically to be the gut issues in this policy statement. I will highlight that.

First, there is one paragraph that I would like to read. It says:

> * * *Combined with business pressures for high and earlier return on investment. This creates a general concentration of company funds on R&T with near-term payoffs. But we also confirm that it is very difficult for companies to justify investment and longer term aeronautical research because they can't capture the benefits for themselves. As a consequence, we see no alternative but continued government support if we expect to maintain the level of research and technology demanded by the national interests.

You know, I got to the point where I didn't think I would ever see this again as it pertains to aeronautical research and technology. It is vital, absolutely vital. The aeronautical industry is not a sunset industry. It is anything but.

In getting it done, the policy statement also gets more specific. It says, "Overall, the Federal Government will assume responsibility for two general areas. One is support of aero R&T development, these activities which run from basic research through validation of design procedures"—I want to underline that, validation of design procedures, because that is what we have not been doing—"or characterized by a large degree of uncertainty in outcome, but they underlie all new aircraft and systems development.

"The second area is demonstration of technologies for military applications." That, again, is very vital. We have not been doing that. We have not been doing the demonstrations. "This is the final activity before actual systems development and provides the basis for decisions on final design."

Further in the policy report there are two other statements which say, "* * *insure the timely provision of a proven technology base to support future development of superior aircraft and to insure the timely provision of a proven technology base of safe, efficient and environmentally compatible air transportation systems." That really is saying a mouthful as far as I am concerned.

Now, for the Government to accomplish this will require a major change of emphasis on what I call applied research and technology. I compliment the White House for getting the word technology in, because technology says something different to me than just development.

I think we understand basic research quite well. I think we understand weapons systems development quite well. But the applied area is one that has not been understood well and we haven't done it well, as far as the Government is concerned. It is the most costly of the research and technology, not counting weapons system procurement.

Here is what I have observed, particularly during the last 20 years, which I think have been highly negative to what we now have in the policy.

There has been a virtual disappearance of experimental prototypes. In Dr. Augustine's statement he says in 1945 to 1960 the new aircraft every 5 years amounted from 50 to 70; 1981-82, one.

When I was a test pilot at Wright Field in 1939 and 1940, I flew as many as four or five prototypes in the same day. If we hadn't been flying those prototypes, we wouldn't have had the aircraft to fight World War II with.

I consider this an extremely vital area. We have to start building some demonstration prototypes.

Second, there has been a failure to support what I call high potential technology in the applications area; in other words, validation of design procedures. I will give you an example of that.

I was chairman of the project forecast in 1963 and 1964, and we identified composite materials as having probably the highest potential for future application in aeronautics. We got the nonprofit organizations, such as Rand, SRI to make studies, as well as certain companies within the aircraft industry.

Without exception, each study indicated that we could save as much as 30 to 40 percent in structural weight if we developed composites. We put together an applications program which was put on a time scale of about 5 years at a cost of around $300 million. I could get nowhere with it. Didn't even get $5 million for it. So we have just been piecemealing this composite business for the last 20 years.

We should have had an all-composite research airplane flying several years ago. We have practically done nothing on hypersonic flight. We put boundary layer control on the shelf. Very little has been done on supersonic flight. I just give these as examples of what hasn't been done in the past 20 years.

Let me talk about NASA for a moment. I participated in all the hearings having to do with the creation of NASA. I got into a lot of trouble with some of the comments I made at the time.

NASA has done just exactly what I thought it was going to do. They have been absolutely preoccupied with space. The budgets became austere and aeronautics became the step-child.

Then of course another problem was the demise of the NACA Advisory Board. I not only wrote letters to Keith Lennon and to Jim Webb, but I talked to them and said, look, that is the area that you have got to put more emphasis on.

I know both Keith and Jim very well, they are good friends of mine, but they were caught between a rock and a hard place and they simply didn't have enough money to do both of what was being asked in space and in the aeronautics area. I talked to every administrator since, but now I hope this policy will do something with respect to getting aeronautics back on the track.

The White House didn't help very much, either. I was the chairman of what was called the President's Advisory Council on Management Improvement from 1969 to 1973. I also worked with Bill Magruder on a number of initiatives that were considered to be in the area of crisis proportions; that is, initiatives that the Government should undertake to forestall or correct crisis situations. Among those was included what the Government sector should do with respect to research and technology.

We also made a study—and PACMI was the management advisory committee—on R&T. There was a body of opinion, primarily in the White House, that the private sector could do all of the R&T that was necessary, particularly specifically in the aeronautics area.

We had a number of meetings which I attended. I got no place. We actually kept going downhill with respect to our R&T government support.

Since I retired—I have been retired for 16 years—I have been on a number of boards and there isn't a single company that will put money into the long-term research and technology, and that includes the aerospace industry. They should do more of it than anyone else. The only industry that has been putting money into long-term technology is the computer industry.

We have said everything that needs to be said, I think, with respect to the need for doing this government research and technology to support aeronautics.

I would like to just summarize at this point by saying that as a result of what I consider these erroneous policies of the past 20 years, we have not advanced nearly as fast as we should have in the aeronautics area. We have been going to the bank to withdraw and we haven't deposited very much. Competition is very fast catching up with us.

Fortunately, the new aeronautics R&T policy adequately addresses these problems. I was really surprised. I didn't even know it was out. Nobody pays much attention to me anymore these days. I didn't know it was out until I got a call from Scott Crossfield, so I immediately got a couple of copies.

It is excellent. Now we need to implement it. As I have already said, I think that the recommendations that have been made by the witnesses here today are all well thought out and very important. The eight point implementing program that Mr. Album read to the committee I found to be right down the alley of what I believe is the proper way to proceed.

It is going to take more money, there is just no question about it, because applications type of activity are more expensive than basic research or just technology programs. The applications side simply costs more.

You can't buy a prototype aircraft, for example. I think NASA should have research prototype aircraft, and the military should have aircraft that are pointed toward military application, but nevertheless experimental aircraft, not necessarily aimed at going into a weapons systems program.

That concludes the comments that I have put together rather hurriedly. I would be happy to answer any questions you might have.

Mr. GLICKMAN. I want to thank you for your excellent testimony and pleased that Scott was able to get you here. You know, the staff and I went to Dryden, Edwards Air Force Base. We walked around and saw what research aircraft were there. There aren't very many. A lot of them are on the verge of extinction because of financial limitations.

That message did get through to us, that the fact of the matter is that we have been so preoccupied with limiting the role of the Government, proving that we are doing basic research and the next suceeding year is more and more basic research.

You get to the point where you are trying to find the component pieces of research and having no overview, no objective for what you were trying to do, it was self-defeating. I am aware of the role that you had to turn that around, both when you were in the service and outside of the service.

I guess the thing I would like to ask you about is the necessity to have the validation as part of the Government effort. That is the thing that we have been fighting for so many years, that both this administration and the last one and perhaps the last five have felt that that is no function of Government whatsoever. It has probably pushed us back a few years with respect to the rest of the world.

General SCHRIEVER. I can't agree that it is no function of Government. No. 1, if we hadn't had a lot of experimental prototypes prior to World War II in the thirties, we would not have had an adequate Air Force or flying capability in World War II.

Let me go to the period right after the war. We moved into the jet age very rapidly in the military, but we must have had 25 or 30 different prototypes flying, of which only a few finally evolved into a military vehicle. It got us into the jet age in a hurry.

In commercial jet aircraft, we didn't really reach commercial jet aircraft until after we had developed the tanker. Then the tanker went into a commercial vehicle, the 707. That was in the late fifties. We were long flying jet aircraft in the military.

I don't think we could have moved that rapidly under any circumstances without a large number of prototypes in that particular time period.

There is another factor that is pertinent today; that is, with the high cost of weapons systems, the DOD policy has gone more and more toward less and less risk in a weapons system program. In other words, when they give the go-ahead, they want to be sure that it is well understood technology and that there is no real major risk involved.

I know the major companies are very reluctant to present in their proposals highly innovative ideas because they are afraid they will be rejected simply because they have been more innovative.

How are you going to get to the point of having these innovations proved out unless you do the applied work, either in the demonstration vehicle or in a demonstration program like in the composites area?

You meet yourself coming and going here. I think it is absolutely vital. I didn't even consider the F-16 and F-17 as the kind of prototypes that I am talking about. I am talking about experimental prototypes. These were not really experimental prototypes by my definition.

Mr. GLICKMAN. Mr. Carney, do you want to comment?

Mr. CARNEY. Yes, Mr. Chairman, if you would be kind enough to yield.

Along those lines, General, I had the opportunity to speak with many of your colleagues, particularly in the Air Force and in the Navy, dealing with aircraft. For the last couple of months I have been out to Edwards and to many of our facilities where we are doing work on military aircraft.

The consensus that I seem to get from the people involved with military aircraft is that they prefer to go now to a cycle of evolution within an airframe and improvement rather than revolution.

That is coming from, to use a broad-based term, the Pentagon. That in itself would stymie what you are trying to bring back: more prototypes, more research into the revolutionary breakthrough.

Would you like to talk to that conflict? Maybe I read it wrong.

General SCHRIEVER. I think they have been forced into an evolutionary process. In other words, I think we could have much more composites in our military aircraft today had we gone through the applications type program that I mentioned in my comments.

You are not going to get industry to come in with revolutionary approaches if they don't have any back-up from applications type of activity. We called it advanced development, but I would like to call it applications technology. That is not so cheap, and that is what has been missing. The aircraft industry can hardly take that on alone because usually the payoff is too far downstream.

The composites are coming in. I know Boeing—and Jack, you are using quite a bit of composites in your new aircraft and will probably use more in the future, but it has been very slow in coming.

Mr. CARNEY. Again, with composites we see more evolution than revolution. We are using composites on perhaps the same types of air frames, like the AV-8A, the AV-8B went to composites. Same type of plane, though, it is not a revolutionary breakthrough in an air frame or a type of aircraft.

General SCHRIEVER. But if you take composites out to their end, there are many other benefits that can be derived. In other words, if you reduce the air frame weight empty by say 25 or 30 percent, that does a lot of things for you in the way of payload and in the way of range and in the way of size. In other words, it has a multiplying effect on what——

Mr. GLICKMAN. In all fairness, of course, NASA has been trying to get a composite wing program funded for a while. They have had some difficulties. Probably what we should have had several years ago, was a development of a composite airplane.

General SCHRIEVER. I was going to bring a couple reports that I had here dating back to 1970 and 1971, in which recommendations were made for doing certain things. None of them were accepted. It has been a very slow process, in my opinion, of the very high potential technology.

I picked that out merely as an example. There are others, but I have not been that closely involved in the details in the recent years.

Mr. GLICKMAN. Mr. Dunn, do you have any questions of the General?

Mr. DUNN. I am sorry that I came in late. I don't really have any questions.

I wasn't sure of the point you were making there in terms of history. You were talking about our advancement, going to World War II and after we came out of World War II how quickly we moved into the jet age.

Correct me if my history is wrong, but I believe the first jet airplane flown by the U.S. Air Force was ME-262, which is a captured German jet.

General SCHRIEVER. I am not sure that that was the first one we flew, but we did capture one and we did fly it. The Germans beat us to the jet, no question about that.

Mr. DUNN. My point is just how far have we really gotten. The Germans beat us to the rockets. German aircraft and Japanese aircraft going back to World War II were ahead of us. I guess I am agreeing with the chairman and the point of this testimony, that for too long we have neglected aircraft research in this country.

General SCHRIEVER. That is what I believe, too.

Mr. GLICKMAN. Mr. Carney?

Mr. CARNEY. I would just like to make a comment, General.

I certainly appreciated your testimony. It was very, very informative. I only wish you had more time.

The one thing that I notice—and you brought that out—is the fact that we have only one prototype in 1981-82, and that this is not new with this administration; it has been a symptomatic thing through past administrations back to the Nixon administration and even before that.

It probably came about with the creation of NASA and the priorites within NASA. That is something that we are going to have to go back as a committee and look at very, very carefully, and go in there and scratch and fight and tear and rip to get money for aviation out of the NASA budget. It doesn't have the same type of appeal that space does. That is a problem that we have. I certainly recognize that.

I would also say, too, that when you talk about prototypes back then, you are dealing with putting together a prototype for maybe $300,000; they weren't very complicated, the avionics weren't. You were dealing with airframes and you were dealing with machine guns and a turret.

Today the complexities of the aircraft, the airframe, the weapons and everything are far greater. It is not the same to have 25 or 30 different prototypes in today's market as it would have been back then. An aircraft today is $40 million flying over the fence. Those same companies were flying hundreds of aircraft over the fence back then for that type of money.

General SCHRIEVER. To do the aeronautics development, though, you don't need to put all the systems on board. Now on B-1 I have read numbers like $160 million for one airplane. I think on a relative scale you could still build aeronautical type prototypes for perhaps within some kind of a relative scale of what a fighting machine costs versus a prototype in the old days. Sure it will cost more, but everything costs more.

Mr. GLICKMAN. General, we thank you for your testimony. Even though you didn't have a prepared statement nor lots of high-paid staff to help you, I would say it was one of the most productive pieces of testimony we had today.

General SCHRIEVER. Maybe it was one of the most emotional.

Mr. GLICKMAN. We have two votes on the floor. This is a vote on the rule for the continuing appropriations.

I know that you had some questions of Dr. Reis. Do you want to come back, in which case after we vote you would just chair the completion of this, or we could submit them for the record. I am sure you would respond in writing to questions from Mr. Carney.

Mr. CARNEY. I probably could ask them in a 5-minute timeframe, not to hold up everybody. We have perhaps 11 minutes left in this vote.

Mr. GLICKMAN. I will go ahead and you can complete the hearing then.

I just want to thank the witnesses for a productive day and also for the fact that maybe we are seeing a new day, a new dawn on aeronautics policy in America. Maybe it will be transferred to other industries as well.

Mr. Carney, why don't you go ahead and complete the hearing.

Mr. CARNEY. Thank you, Mr. Chairman.

This is an outstanding moment in my career. I find myself chairman of a subcommittee.

Mr. GLICKMAN. No, you are not chairman of the subcommittee, you are just chairing the hearing. [Laughter.]

Mr. CARNEY [chairing]. I have a couple of questions. I again apologize. I was on an earlier flight and we had to stay on the ground on Long Island because of the traffic problem here.

One of the questions I would like to ask is what is the impact of the new policy on NASA's ability to conduct R&T for the civil sector?

Mr. REIS. That is a very good question. There are two parts to that question.

One is, is there really a difference between the R&T that NASA does for the military and what they do for the commercial sector. We struggled quite a bit on this question and discovered that there really is very little difference between military and civil R&T. Other people have commented on that as well.

Almost all of the research—I won't say all, but perhaps 90 or 95 of the research—that NASA does is common to both civil and military and, I should add, general aviation shares in that beneficence.

Mr. CARNEY. With the vital importance of aeronautics to our national security, why does this new policy endorse a special and independent role for NASA in aeronautical R&T?

Mr. REIS. I think the key to the answer is in the way you phrase that question; independence. It is important, I believe, that much of the R&D that we do is independent of a particular application. If a program manager was in complete control of the R&D, very often he would not get the type of independent response that he wishes.

That approach has developed by NASA through the years and NASA takes a considerable pride in its independence. The Department of Defense understands that they can get research from NASA that NASA validates and certifies is the best they can produce, regardless of the particular application.

Mr. CARNEY. What you are saying, then, is that you are endorsing a policy of license, almost like academic license?

Mr. REIS. In a sense that is true, and that independence is very important. Of course, NASA is not an academic institution; but one of the things we discovered during the course of the study is just how good the close working relationship at the working level is between NASA and the Department of Defense; they share data, they share information.

I think you mentioned Edwards Air Force Base and Dryden Research Center are co-located. That is a tradition that goes back to 1915 and it is one that I think is valid and which we encourage very much.

Mr. CARNEY. That brings up my next point. There is a large commonality in the R&T and the multiple agencies conducting this R&T. Can you tell me specifically what is being done to insure the proper coordination between agencies such as DOD and NASA?

Mr. REIS. There are a number of coordinating boards now, but one of the recommendations that we made and we feel is very important for the implementation of the policy is a high-level committee that includes not just NASA and DOD but industry as well, to look at long-term policy issues.

Most of the coordinating that is now done tends to be focused on the short-term issues. What we felt was lacking was a return to something like the previous NACA where you had a group similar to a board of directors, which could look at the broader issues and assure that the policy is implemented.

It is the implementation that I believe is most important and we feel that such a group would be a very valuable tool in assuring that implementation takes place.

Mr. CARNEY. Implementation was a word used continually through today's hearing. It is rather obvious to me from all the witnesses that have come before us that they are quite satisfied with the document, quite satisfied with the policy, and somewhat concerned about implementation.

I am not saying that in the form of a question, I am saying that in the form of a statement, more or less. Hopefully that concern about implementation will be shared by not only the members of this committee but Members of Congress and members of the executive side of the Government and we can go forward.

I have a question to ask, particularly in light of today's times; that is, why is aeronautics singled out for strong Government support in the R&T role while most other industries do not receive that same type of support or that same type of interest?

Mr. REIS. I think the reason that aeronautics got special treatment is in large measure because of its importance to national security and the fact that our civil aviation industry is a world leader. We like to bet on winners.

Let me relate my personal interest in how this study started. My office particularly deals with national security affairs. The President, as you know, last August announced a new strategic modernization program.

If you tick off the elements of that program; cruise missiles, B-1, advanced technology bomber, perhaps 50 to 60 percent of that program are aviation related.

I felt that it was foolhardy not to insure that our R&D establishment, which has to back up over the next 20 to 25 years, is in a healthy condition. In large measure, that was the genesis for the start of this analysis.

It really is a very strong national security concern, where I use the words "national security" in the broad sense that Jack Steiner used it.

Mr. CARNEY. Am I mistaken, though, that most of the areas that we are dealing in in national security, particularly in aeronautics, are not the types of thing that you can transfer over to the commercial sector?

Mr. REIS. Actually, only a very few of the national security aspects, per se, cannot be transferred. Obviously, you don't have a B-1 that suddenly becomes a transport or an F-16 into a general aviation airplane. On the other hand, the research in terms of composite materials that General Schriever and a number of people mentioned—the avionics, the different types of propulsion—the interaction between the civil and the military engine developments are very common.

The group spent a lot of time and effort trying to draw a fine line between military and civil but couldn't do it in any meaningful way.

When you are dealing in research, in technology development and even in some degree technology demonstrations the line is very fuzzy and one where reasonable people can disagree.

It just didn't make any sense to try to say this is just military and therefore the military should fund it; this is just commercial, therefore the commercial people or NASA should just fund it. What we are trying to develop is a technology base that can be shared by both sectors of the national aeronautics enterprise.

Mr. CARNEY. If I may wander, take a little congressional license, what would be the benefit of Stealth technology for commercial use? My point is that I think, primarily, this is what we are trying to do. We are trying to move into that type of arena militarily.

Mr. REIS. Without discussing Stealth specifically that is a classified subject—let me suggest, however, that you will be dealing in new techniques, new types of avionics systems, new types of controls, different types of materials, and so forth.

If you think in terms of a technology base, all of these things are applicable to commercial aviation as well. One always wants to have a cheaper, more effective, more efficient aircraft for whatever purpose.

There may be very specific items that are not needed—it is hard to believe that you would necessarily want to have a low radar cross-section like that on a commercial airplane, but the technology and understanding that goes into producing such an airplane would be applicable.

Mr. CARNEY. I think that is good. I threw that out, more or less deciding to throw you a hand grenade, but I think it brings out a very important aspect of this; that is, oftentimes when you are looking to find an answer to a problem—for instance, hiding and disguising an aircraft in a military sense—the benefit that society gets out of it in a commercial application can be incredible; composites, for one, to try to hide an aircraft.

Mr. REIS. I agree with your general statement; I don't think composites were going to be used.

Mr. CARNEY. Nor did I. We can go back to this same argument when we said, well, why are we spending all this money for space. Who would ever dream of some of the spinoffs that we received from our space program? Your answer on Stealth I think is very, very important, and it is correct that there are other benefits from these types of programs. I think we have to note that.

You stated that aeronautics was still at the frontier of science and the returns of aeronautical R&T are not diminishing. Can you give me some specific examples that substantiate your conclusions?

Mr. REIS. Well, there are a number of examples in the report itself. I can go through them. Again, composites is the one that we have talked about and is clearly one that is very important.

I think an interesting fact about aircraft and aeronautics is that its elements are synergistic. An improvement in composites in turn will allow improvements in aerodynamics and in turn permit different types of aerodynamic configurations, particularly coupled with the ability of modern avionics to fly unstable airplanes. This in turn allows different types of construction materials.

I was most impressed by the fact that there wasn't any single area that, if improved, great things would happen. It was the combination of things that allowed us to make very positive but I believe, very realistic statements about what I think the future of aeronautical R&T will hold for the country.

Mr. CARNEY. I think there was another consensus today from everyone; that is, that there will be a large market in the future for both military and civil aircraft.

Under those premises—and I didn't hear anyone disagree with that—why can't industry itself conduct their own R&T, if given tax credits or other incentives, such as patent or antitrust law changes?

Mr. REIS. Those types of incentives would be helpful, but a main finding of the study—and we looked at this very, very carefully—is that many of the research developments in aeronautics just take a very long time to come to fruition, and that industry is very much dominated, as you would expect it to be, by the short-term returns on their investment.

Many of the developments in aeronautics, the payoffs, turn out to take 10 or 15 years.

The second reason is that an aircraft is a very complex system involving many, many different disciplines. It would be very difficult for a single company to invest in all of these disciplines; or if it just invested in one, it is not clear that it would get any return on that investment.

Mr. CARNEY. Doctor, I really appreciate your patience. Again, I apologize to everybody for coming in late, but there were several questions that I wanted to ask of you.

I think, in conclusion—and I know the chairman would agree with me that this hearing was very, very important—it seems like we have an awful lot of people now on the same sheet of music. Hopefully we can sing a tune that will be beneficial to the industry and be beneficial to our national security and beneficial to everyone concerned with the aviation industry.

We have a lot of work to do in front of us, and I think we are going to have the proper atmosphere in which to do it. Obviously everyone wants to carry out this policy that has been created.

I would like to express my appreciation on behalf of the chairman and other members of this committee to everyone who participated today. Thank you very much.

Mr. REIS. Thank you, Mr. Chairman.

Mr. CARNEY. The meeting is adjourned.

[Whereupon, at 12:32 p.m. the subcommittee adjourned.]

APPENDIX

STATEMENT OF LT. GEN. KELLY H. BURKE (RET.)
CONSULTANT

TO THE SUBCOMMITTEE ON TRANSPORATION, AVIATION AND MATERIALS
COMMITTEE ON SCIENCE AND TECHNOLOGY
UNITED STATES HOUSE OF REPRESENTATIVES

HEARINGS ON FEDERAL AERONAUTICS RESEARCH AND TECHNOLOGY POLICY

DECEMBER 14, 1982

CHAIRMAN GLICKMAN AND MEMBERS OF THE SUBCOMMITTEE:

I AM PLEASED TO HAVE THIS OPPORTUNITY TO ADDRESS THIS SUBCOMMITTEE ON THE NEW FEDERAL POLICY FOR AERONAUTICAL RESEARCH AND TECHNOLOGY.

MR. CHAIRMAN, I HAVE BEEN INVOLVED IN AERONAUTICS THROUGHOUT MY 30 YEAR CAREER WITH THE UNITED STATES AIR FORCE, MOST RECENTLY IN MY POSITION AS DEPUTY CHIEF OF STAFF FOR RESEARCH, DEVELOPMENT AND ACQUISITION FROM NOVEMBER 1979 TO JULY 1982. LET ME SAY AT THE OUTSET THAT I STRONGLY ENDORSE THIS POLICY AND I FEEL IT IS A SIGNIFICANT STEP FORWARD FOR U.S. AERONAUTICS.

THE NEW POLICY CLEARLY RECOGNIZES THE CRITICAL IMPORTANCE OF AERONAUTICS TO OUR NATIONAL SECURITY. IN FACT, ABOUT ONE THIRD OF THE ENTIRE DOD BUDGET IS FOR PROCUREMENT, MAINTENANCE, AND OPERATION OF AERONAUTICAL SYSTEMS, AND THERE IS LITTLE DOUBT THAT THEY WILL CONTINUE TO FULFILL A MAJOR DEFENSE ROLE. WE DEPEND HEAVILY ON TECHNICALLY SUPERIOR AIRCRAFT WEAPON SYSTEMS TO COUNTER THE NUMERICALLY SUPERIOR SOVIET THREAT. ALL OF US KNOW THAT THE SUPERIORITY OF U.S. MILITARY AIRCRAFT IS NO ACCIDENT. IT IS LARGELY A CONSEQUENCE OF THE RICH GOVERNMENT-SUPPORTED AERONAUTICAL R&T BASE AND THE OUTSTANDINGLY EFFECTIVE PARTNERSHIP BETWEEN GOVERNMENT AND INDUSTRY. FURTHER, AGGRESSIVE AERONAUTICAL R&T STILL OFFERS A WEALTH

OF OPPORTUNTIES FOR SUBSTANTIAL TECHNOLOGICAL IMPROVEMENTS IN MILITARY AIRCRAFT EFFECTIVENESS AND COST. BY THE YEAR 2000, INCORPORATION OF ADVANCED AERONAUTICAL TECHNOLOGIES SHOULD ADD MILITARY CAPABILITY EQUIVALENT TO MANY BILLIONS OF DOLLARS THAT WOULD OTHERWISE BE REQUIRED FOR LESS CAPABLE UNITS OF EQUIPMENT.

I AM ENCOURAGED THAT THE NEW POLICY ALSO RECOGNIZES THE IMPORTANCE AND REAFFIMS THE CURRENT DIVISION OF RESPONSIBILITIES BETWEEN DoD AND NASA. THIS WILL CONTINUE TO ENSURE THAT SPECIFIC AND TIMELY MILITARY AERONAUTICAL R&T NEEDS ARE MET BY DoD R&T DEVELOPMENT AND TECHNOLOGY DEMONSTRATION PROGRAMS. IN ADDITION, THE INDEPENDENCE OF NASA REMAINS AN ASSET TO BOTH DoD AND INDUSTRY, PROVIDING A LONG-TERM PERSPECTIVE AND PURSUIT OF HIGH RISK TECHNOLOGY OPPORTUNITIES FREE FROM SHORT TERM DEVELOPMENT AND OPERATIONAL PRESSURES, AND SPECIFIC MISSION REQUIREMENTS.

IN CONCLUSION, I BELIEVE THE WIDESPREAD PARTICIPATION BY FEDERAL AGENCIES, INDUSTRY AND THE UNIVERSITITIES IN FORMULATING THIS NEW POLICY HAS PRODUCED AN IMPORTANT AND THOUGHTFUL POLICY THAT WILL SERVE US WELL IN THE COMING YEARS.

AERONAUTICAL RESEARCH AND TECHNOLOGY POLICY

VOLUME I

SUMMARY REPORT

I. INTRODUCTION

Since 1915, the U.S. government has provided national leadership and significant financial support for the development of aeronautical research and technology (R&T). Approximately one-third of the U.S. defense budget is spent on aeronautical products and their support, and commercial aircraft sales contribute the largest positive balance of trade among U.S. manufactured goods. Superior aeronautical R&T has been essential to the current U.S. preeminence in both military and civil aviation. Given the ever-increasing Soviet military pressures and foreign commercial aviation competition, future preeminence depends on effective U.S. R&T programs. Significant questions have been raised concerning the appropriateness and effectiveness of current U.S. aeronautical R&T policies, and the U.S. government's role in support of aeronautical R&T.

In response to these questions, the Office of Science and Technology Policy (OSTP), in the Executive Office of the President, chaired a multi-agency study group that reviewed national aeronautical R&T policy. The following central issues and/or questions were addressed:

- Is aeronautics a mature technology and is continued investment justified by potential benefits?
- What are the proper government roles in aeronautical R&T and does the present institutional framework satisfy these roles or should it be changed?

The study was conducted from February 1982 through August 1982 by an interagency working group and a senior-level steering group consisting of individuals from: OSTP (chair), the Office of Management and Budget (OMB), Council of Economic Advisors (CEA), Department of Defense (DOD), National Aeronautics and Space Administration (NASA), Department of Transportation [Federal Aviation Administration (FAA)], and Department of Commerce (DOC). Two observers, one from industry and one from the university community, also participated. Further data were acquired from an extensive questionnaire sent to aeronautical industry leaders and from interviews with their representatives. While considering the broad range of aeronautics and aeronautical R&T, the study group concentrated on the air vehicle and only peripherally addressed external weapon systems and air traffic control systems. The study group reviewed past and current government policies on aeronautical research, and extensively addressed current and future needs, capabilities, and incentives for such research in both government and private industry. Analysis of policy options and alternatives resulted in specific findings and recommendations. This summary report, Volume I, provides the study findings and recommendations in brief, and a summary of the major rationale that led to these results. Volume II provides analyses and data to support the results. Volume I was fully reviewed and approved by all agencies represented on the Steering Group (OSTP, OMB, CEA, DOD, NASA, FAA, DOC) and further reviewed and approved by the National Security Council (NSC) and the Office of the U.S. Trade Representatives (USTR). Volume II was reviewed and approved by members and agency support staff on the working group. This study was accomplished to aid senior Administration officials in establishing and implementing policies affecting aeronautical R&T.

Victor H Reis
Victor Reis
Steering Group Chairman

Louis T. Montulli
Louis Montulli
Working Group Chairman

II. KEY TERMINOLOGY

The following definitions have been developed to aid in the understanding of the study recommendations, particularly with respect to government roles. The following definitions differ from those used in previous studies. The present definitions divide the research and development (R&D) process into three major, sequential phases: R&T development, technology demonstration, and system development. As defined here, R&T consists of the first two phases.

The initial phase, R&T development, consists of activities primarily aimed at producing physical understanding, new concepts, design data, and validated design procedures for aircraft systems, subsystems, and components. It consists of activities ranging from theoretical analysis to laboratory investigations to flight-testing experimental aircraft. These activities tend to have a large degree of uncertainty in their outcome. They are typified by the activities conducted in DOD budget categories 6.1, 6.2, and some of 6.3A, and in NASA budget categories "R&T Base" and, with some exceptions, "Systems Technology."

The second phase, technology demonstration, consists of activities primarily aimed at demonstrating improved subsystem or system characteristics to provide the development and manufacturing decisionmaker with the confidence that the anticipated improved level of performance is indeed achievable in a new system. The technology demonstration efforts are characterized by testing configurations similar to the intended applications and by a modest degree of uncertainty in outcome. These efforts are the final technology activity before system development, but before a decision to develop a specific system is made. A transition activity, which occurs during some of the large-scale testing stages of technology development and during technology demonstration, ensures effective and efficient handoff to industry for military and civil development.

The third phase, system development, consists of activities aimed at producing a specific aircraft or specific aircraft system for operational use (beginning with DOD budget category 6.3B).

The key criterion in applying the definitions of technology development and technology demonstration is the nature of the intended results, not the physical mechanisms selected to conduct the effort. Because a single program may be intended for more than one purpose, categorizing an activity as either technology development or technology demonstration therefore requires the exercise of informed judgment, with emphasis on the intended output (understanding, design data, validated design procedures versus demonstrated system/subsystem performance) and on the technical risk or the research questions being addressed.

The following examples* of DOD, NASA, and industry current or recent activities show the broad range of R&T development:

- DOD [6.1] propulsion programs in fundamental internal aerothermodynamics, combustion processes, turbomachinery turbulence studies, and analytical methods development
- NASA [R&T Base] exploration of the mechanical breakup of boundary layer eddies to reduce turbulent drag
- NASA [R&T Base] analytical and experimental examination of aeroelastic behavior of new structural concepts, including flight tests on remotely piloted vehicles
- DOD [6.2] development and testing of propulsion components, including compressors, turbines, and combustors, and similar [6.2] activities on structural components and aerodynamic configurations
- NASA [R&T Base] analytical and experimental investigations of bearings, gears, and lubricants, including studies of friction and wear, and determination of dynamic loading effects on material behavior
- DOD [6.3A] exploration and improved understanding of interrelationships between life and performance in advanced high-temperature engines (as part of Joint Technology Demonstrator Engine program)
- NASA [Systems Technology] program to generate and test new concepts for practical systems to maintain laminar

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*These examples are presented to clarify the scope and character of aeronautical R&T development and technology demonstration phases. They are not intended to imply any assessment of the merit of these programs.

flow on large subsonic aircraft, including: analytical derivation of airfoils, suction requirements, and structural systems; and wind-tunnel and flight-testing of promising concepts

- Joint DOD/NASA [6.3A/Systems Technology] experimental flight tests on tilt-rotor concepts to generate a design data base and to validate aeroelastic analysis and design procedures for future tilt-rotor vehicles
- Joint DOD/NASA [6.3A/Systems Technology] flight-testing on modified fighter to investigate experimental mission-oriented subsystems, including coupled flight control and fire control, and independent mode motion/direction control
- NASA [Systems Technology] construction of and flight research on an upper-surface-blowing research airplane to develop handling qualities and design criteria, basic design data, and validated analysis and engineering procedures for propulsive-lift aircraft
- NASA [Systems Technology] program to develop data base and design criteria for small- and medium-size composite primary aircraft structures, including: analysis, design, and testing of components; generation of data on design procedures, fabrication techniques, and operational environment effects; service-life testing of representative transport rudders, elevators, and ailerons; and flight-testing of transport horizontal stabilizer
- NASA [Systems Technology] program investigating new energy-efficiency concepts in aerodynamics and active controls technology for application to future transport or patrol aircraft, including analysis, wind-tunnel testing, and flight research on high-aspect-ratio supercritical wings, winglets, nacelle/airframe integration, and active control system concepts
- Industry development of proprietary structural analysis and design techniques.

The following are examples of technology demonstration:

- DOD [6.3A] performance demonstration of complete engine systems (as part of Joint Technology Demonstrator Engine program)

- NASA [Systems Technology] flight demonstration of an active-control wing load alleviation system designed for a specific wide-body transport (a phase of transport energy-efficient technology development program)

- DOD [6.3A] design, fabrication, and flight demonstration of an all-composite fuselage using a nonmilitary helicopter to provide confidence in projected cost, weight, and manufacturability

- NASA [Systems Technology] performance demonstration portion of integrated-core/low-spool assembly testing that incorporated advanced high-efficiency turbofan engine components as final 10 percent of energy-efficient engine technology development program

- NASA [Systems Technology] program in which a modified JT8D engine (with larger fan diameter to increase bypass ratio and reduce noise) was installed and demonstrated on a DC-9 airplane to assist the FAA in considering the application of more stringent noise regulations to existing transport aircraft

- Joint DOD/NASA [6.3A/Systems Technology] flight-testing to investigate and demonstrate performance of aileron-rudder-interconnect flight control system modification on an operational fighter to improve handling qualities in tracking and at high angles of attack

- Industry flight-testing of multiple engine and nacelle combinations on a B-747 test-bed aircraft.

The following are examples of systems development:

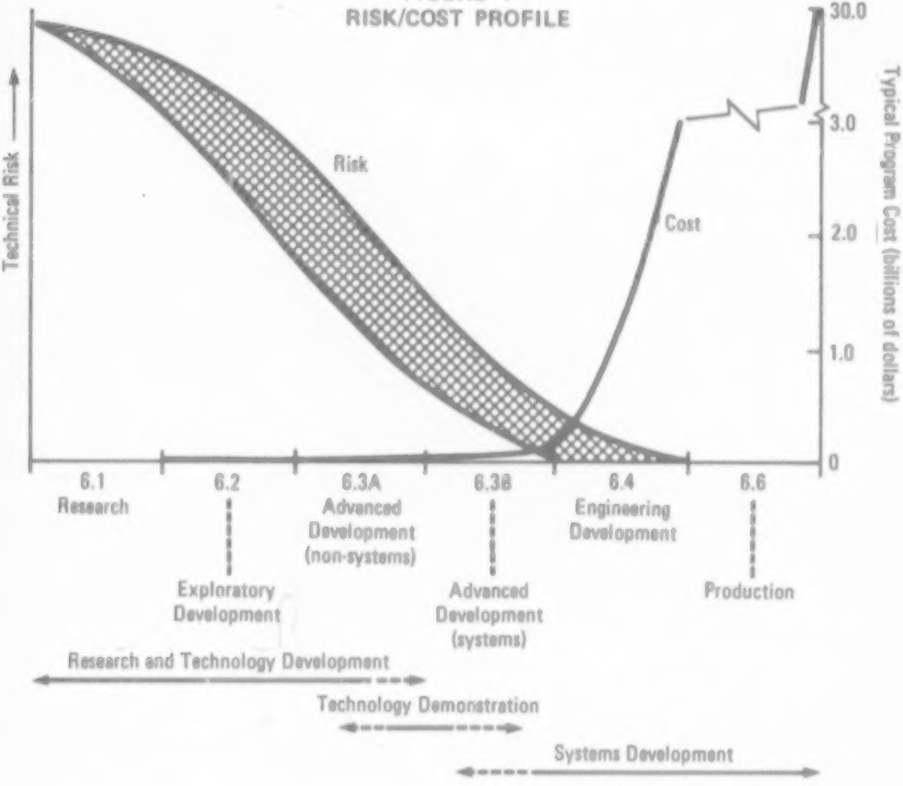
- DOD [6.3B] advanced tactical fighter activity, the first phase of a development program for a new fighter aircraft system

- DOD [6.4] B-1 full-scale development and prototype testing

- Industry full-scale development and prototype testing of B-757 and B-767.

The three phases represent a continuous spectrum of related activities in the R&D process, in which technology is generated, demonstrated, and transferred into system development. Figure 1 illustrates the typical cost variation of a single program in the category listed, not the cost of a single aircraft program as it proceeds through the R&D spectrum. As expected, development and production costs dominate R&T costs. Superimposed is a notional representation of the technical risk associated with the development of new technology. This is presented to illustrate that in the early research stages--i.e., 6.1, 6.2--the emerging concept is generally a high technical risk from the development manager's perspective. As successful technology programs proceed through the advanced development and demonstration phases, the technical risk is lowered by providing the evidence required to prudently accept the advanced technology into engineering development.

FIGURE 1
RISK/COST PROFILE



III. FINDINGS AND RECOMMENDATIONS

This chapter presents the study group's findings and principal recommendations.

Findings

The study group presented the following findings:

1. Importance of Aeronautics

- The United States depends heavily on technical superiority of military aircraft for national defense--approximately one-third of the DOD budget is for procurement, maintenance, and operation of aeronautical systems.

- Civil aircraft are the dominant common carrier mode of inter-city travel in the United States. The U.S. government is responsible for air traffic control and safety.

2. Nature of Aeronautics Industry

- A healthy, competitive civil aeronautics manufacturing industry reduces the cost of providing an essential military industrial base and wartime mobilization surge capacity.

- A successful aeronautics industry requires a continuous input of multidisciplined advanced technologies from both inside and outside the aeronautical industry.

- The capital investment required to develop a new aircraft often exceeds the net worth of the sponsoring company.

- Antitrust laws have constrained U.S. companies from domestic joint ventures but have often allowed international joint ventures. However, industry has not yet attempted to take full advantage of recent relaxation of some antitrust constraints.

- Aeronautics industry prosperity is influenced by worldwide economic conditions, foreign trade policies, and government policies, as well as R&T.

3. Aeronautical R&T

- Large gains are expected from continued aeronautical R&T.
- Continued strong advancement in aeronautical R&T is essential for national security and for continued success of the U.S. civil aeronautics industry.
- The aeronautical R&T development activities in support of future military and civil applications are largely common, thereby compounding the value of the resulting research.
- Industry-funded aeronautical R&T is predominantly near-term focused. Private companies have been generally unable to effectively capture the benefits of internally funded aeronautical R&T development. As a result, a market disincentive exists for such R&T activities.

Recommendations

The study group made the following recommendations:

1. National Goals in Aeronautics and Aeronautical R&T

Recognizing aviation's unique role in national defense and its significance in the U.S. transportation system, the study group recommends the following goals for industry and government:

- In Aeronautics
  - Maintain a superior military aeronautical capability.
  - Provide for the safe and efficient use of the national airspace system, vehicles operated within the system, and facilities required for those operations.
  - Maintain an environment in which civil aviation services and manufacturing can flourish.
  - Ensure that the U.S. aeronautical industry has access to and is able to compete fairly in domestic and international markets, consistent with U.S. export policy.

- In Aeronautical R&T
  - Ensure the timely provision of a proven technology base to support future development of superior U.S. aircraft.
  - Ensure the timely provision of a proven technology base for a safe, efficient, and environmentally compatible air transportation system.

2. U.S. Government Role

After considering alternative policies consistent with national needs, objectives, and the U.S. economic system, the study group recommends:

- Government support for aeronautical R&T development and for military aeronautical technology demonstration, consistent with overall government priorities and the availability of funds.

3. Government Agency Roles

The study group recommends that the government maintain the present institutional framework in which

- DOD funds, directs, and implements aeronautical technology development and demonstration programs directed specifically toward military applications.
- NASA funds, directs, and implements aeronautical R&T development programs and supports military aeronautical technology demonstration programs.
- NASA and DOD encourage transfer of aeronautical research results to and within U.S. industry.
- Both DOD and NASA manage, maintain, and operate aeronautical research, development, test, and evaluation facilities.
- The FAA, with NASA and DOD support, is responsible for air traffic control and safety-related aeronautical R&T.

The study group found the general coordination of NASA and DOD programs to be both frequent and highly professional. However, since the creation of NASA in 1958 and the elimination of the NACA Advisory Board, senior aeronautical policy coordination between NASA, DOD, and industry has been weakened. The panel recommends

- o The reinstitution of a high-level NASA, DOD, and industry committee, which would meet at least once a year to review and coordinate all aeronautical R&T policies.

4. Facilities

The study group examined the capabilities and limitations of the existing and developing aeronautical facilities and concluded that present and planned major facilities are adequate. However, continued maintenance and modernization will be required. Specifically, improvements to and expansion of computational capability should be considered.

Disparity in approach to user charges between DOD and NASA facilities creates a significant potential for inappropriate program distribution and use of some facilities. It is recommended that

- o NASA and DOD develop a common framework of appropriate incentives and proper joint management coordinating mechanisms to ensure that the use of NASA and DOD aeronautical facilities is consistent with government priorities and the needs of the user programs.

5. Technology Transfer

The study group viewed the rapid, uncontrolled dissemination of unclassified aeronautical R&T data by the United States to foreign parties as detrimental to U.S. preeminence in military and civil aviation. The group further determined that significant, high-quality aeronautical R&T is being accomplished by many developed countries. The United States is not now fully collecting and utilizing this available, unclassified foreign technology. After a study of technology transfer, including a review by DOD and other agencies, the study group recommends that

- o NASA and DOD, in conjunction with other U.S. government and non-government agencies, review the procedures for disseminating aeronautical R&T documents.
- o NASA provide a plan for a centralized means of collecting unclassified aeronautical R&T documents, conference proceedings, and meeting results.

IV. ORIGINS AND HISTORY

An historical review provides an insight into the major government policies and world events that influenced the development of U.S. aeronautics. The government's concern for military aeronautical needs repeatedly inspired major advances in the aeronautics industry. The following summarizes this evolutionary and cyclic process.

The period from the first powered flight in 1903 to 1914 can be characterized by aggressive European aviation development and U.S. government lack of interest. By 1914, only 23 of the 3,700 airplanes in the world were U.S. owned. With the imminence of World War I, the Aviation Section of the Signal Corps was formed in 1914-15, and the National Advisory Committee for Aeronautics (NACA) was established to conduct aerodynamic research. The services and industry were assigned responsibility for research on aircraft structures and engines.

At the end of World War I, the government employed several methods to sustain the momentum of the newly formed aviation industry for military aircraft production. In 1925, President Coolidge appointed a board to study the problems of aircraft development for national defense. The board determined that development of a strong civil aviation industry was important to maintain a sound manufacturing base to meet national defense aircraft production needs. Their conclusions cited several impediments to air transportation progress, including the excessive burden on private capital for developing aircraft and facilities and the uncertainties regarding civil and military demand and government regulation. One key result was that, in 1926, the Department of Commerce was chartered to regulate and encourage civil aviation and to establish the civil airways systems. Subsequent proliferation of airlines as a form of public transportation resulted in the Civil Aeronautics Act of 1938, which established the Civil Aeronautics Board (CAB).

In the late 1930s, the more aggressive research efforts in Europe, particularly in Germany as reported in 1939 by Charles Lindbergh, were again recognized as having successfully provided a substantial European lead in military aviation, particularly through advanced propulsion and structural systems. The U.S. response was to form two additional laboratories, the NACA Ames Aeronautical Laboratory, established in 1940, and the NACA Aircraft Engine Research

Laboratory (now Lewis Research Center), which became functional in 1942.

NACA's large growth during World War II and the demands of the war effort made the roles of military, industry, and NACA difficult to distinguish. However, early postwar policy defined the NACA role as fundamental research: industry was responsible for development and the military for evaluation. In 1949, Congress passed the Unitary Wind Tunnel Act, which created a cooperative program for jet-age aircraft R&D among NACA, the military, and the aircraft industry.

Throughout the 1950s, NACA, the military services, and industry teams jointly conducted long-range research, much of which centered around the X-series of research aircraft. The military procured these vehicles, built by industry to government specifications, for joint NACA/DOD research programs.

With the formation of NASA in 1958, incorporating NACA and its laboratories, the NACA/NASA manpower devoted to aeronautical research dropped from 5,700 in 1957 to under 1,400 in 1963. Much of the NASA aeronautical research was deferred and its manpower transferred to support the space activity. The major burden for providing R&T to meet the continuing military needs was shifted to DOD, although at a significantly decreased level. Aeronautical research in NASA began to resurge in the late 1960s, inspired by aircraft noise problems, a growing concern for future energy shortages, and recognized military requirements. This renewed growth gave fresh impetus to government/industry cooperative research, produced direct results, and brought NASA aeronautics manpower to its current level of approximately 3,800.

The aerospace industry is a high-technology industry that has evolved into a major U.S. enterprise that provided about 1.2 million jobs in the United States in 1981; development and production of aircraft, engines, and parts accounted for 657,000 jobs in 1981. Approximately one-third of the U.S. defense budget is now spent on aeronautical products and their support. In 1981, U.S. manufacturers' direct sales of aircraft, engines, and parts totaled $34.7 billion and produced a positive trade balance of about $13 billion, the largest for any U.S. industry group. Major factors influencing the future prospects of U.S. manufacturers to sustain market growth include worldwide economic conditions, foreign trade policies and practices, government policies, and the sustained development and availability of new and advanced technology.

V. FOREIGN CHALLENGES: CIVIL COMPETITION AND MILITARY THREAT

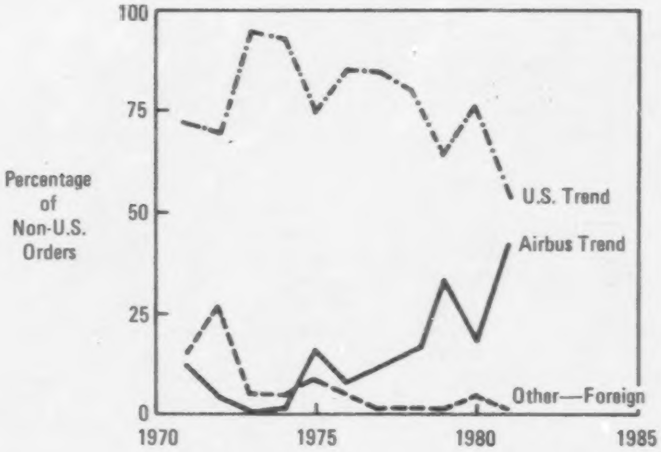
The U.S. aeronautics industry was preeminent at the end of World War II, after which aeronautical capabilities gradually reemerged in each of the major European countries, paced by the Soviet Union. Very aggressive R&D efforts across the spectrum of aeronautics and space were nationally supported in both Eastern and Western Europe. The Western Allies initially concentrated on military systems in concert with, and heavily supported by, U.S. R&T and co-production agreements.

Based on the military-derived technology and production base, application to civil products slowly developed in Western Europe. The United Kingdom had an initial lead after World War II as a result of their work in jet engine technology. The British Comet led the market in the application of advanced technology until structural problems slowed progress. The French Caravelle set the initial pace for aft-fuselage-mounted engines on jet transports, but it was overtaken by the U.S. industry as market requirements evolved to larger size aircraft. Initial market selections by the European manufacturers usually avoided direct competition with the dominant U.S. industry, which had captured approximately 90 percent of the world civil market in 1970. Ultimate formation of the multinational consortia in Western Europe, underwritten by large government subsidization, has resulted in substantial competition in today's world aviation market. Figure 2 illustrates the degree of recent European success in the civil transport market competition.

Aggressive programs for the development of competitive positions in the world market for aeronautical products are emerging in several areas of the world. Embraer, in Brazil, has become a major factor in the light transport or commuter market. Japan, under the guidance of the Ministry of International Trade and Industry (MITI), clearly intends to become a major partner in world aviation sales. In Europe, multinational consortia, as well as individual national efforts, now provide competitive products in nearly all fields of military and commercial aviation.

The numerical superiority of our principal military adversary, the Soviet Union, is unquestioned, as is the fact that Soviet production rates for all classes of military aircraft continue to be much higher than their western counterparts.

FIGURE 2
CIVIL TRANSPORT AIRCRAFT MARKET POSITION



It is estimated that Soviet production rates for tactical aircraft alone are twice those of the United States.

The nine Soviet research institutes working with the eight design bureaus under centralized direction continue to significantly improve existing production aircraft and a range of new aircraft concepts, some of which appear to be nearing production status. Recent introduction into the Soviet military fleet of such aircraft as the YAK-36 (Forger) vertical takeoff and landing (VTOL) combat aircraft, the MI-24 (Hind) helicopter, and the identification of a new variable-sweep bomber larger than either the TU-26 (Backfire) or the U.S. B-1, all indicate an intense concentration on continued improvement of military capability.

Soviet dedication of substantial resources to improved aeronautical research capabilities is evidenced by major high-Mach-number facility construction projects at several Soviet research institutes. Aggressive Soviet R&T programs are a constant challenge to the margin the United States now maintains through technically superior equipment. To preserve that margin, continued advancement in U.S. technological capability in many areas such as aerodynamics, structures, propulsion, avionics, radar, and missiles--as well as in range, payload, speed, altitude, and maneuver capability--is a critical requirement.

VI. NEEDS AND OPPORTUNITIES

U.S. military strategists depend on offsetting Soviet numerical superiority in aircraft by producing fewer yet technologically superior vehicles combined with improved tactics and training. This policy is believed to be advantageous both tactically and economically. However, margins of technical superiority are highly perishable and must constantly be reestablished. Examination of alternatives yields a range of continuing R&T requirements. For example, higher speeds, enhanced high-speed maneuverability, and low observable or stealth technology are key areas strongly supported by military planners. A constant goal of both military and civil aircraft designers is an aircraft with longer range and greater payload for less cost.

Although a vital national security imperative exists and future economic success of a vital U.S. industry is involved, it is appropriate to question whether, after 80 years of intense aircraft development, there are enough potential improvement gains to warrant future aggressive research investment. The study group has strongly concluded that the answer is yes.

To support this conclusion, Volume II of this study documents a broad range of technological advancements possible through a continued strong aeronautical R&T effort. While the improvements in individual aeronautical disciplines can be significant, multiple technologies, when integrated synergistically, can provide much larger improvements in system capability. The following examples illustrate the scope and magnitude of the potential advances in key technical disciplines and some of the resulting system benefits, achievable by the 1990s as related to the current state of the art:

- Aerodynamics
  - Double the supersonic lift to drag ratio
  - Laminar flow control for a 20- to 40-percent reduction in friction drag
  - Continuously variable camber-wing design to optimize aerodynamic performance and significantly increase range and maneuverability

  - Optimized configurations to reduce radar cross section

- Structures and material
  - Composite materials to reduce structural weight by 20 to 30 percent
  - Aeroelastic tailoring of aerodynamic surfaces to reduce weight and improve maneuver performance
  - Superplastic forming and diffusion bonding of metals to reduce fabrication costs

- Propulsion
  - Increased thrust-to-weight ratios by 20 percent
  - Reduced specific fuel consumption by 15 to 20 percent

- Flight Control/Electronics
  - Active controls to increase fuel efficiency by 10 to 15 percent
  - Ultra-reliable systems with 10^{-9} failure rates.

For fighter aircraft, combining advanced aerodynamics, structures, and propulsion technology can enable tactical aircraft to achieve

- Significantly reduced detection range against threat radars and sensors for infrared and other observables
- Small ship deck operations
- Wider missile launch envelopes
- Operation from short/damaged runways
- 25- to 40-percent reduction in design gross weight for the same mission range
- 15- to 25-percent life-cycle-cost reduction compared to current costs.

For strategic bombers, survivability, weapon effectiveness, and range/payload are vital to mission success. Advanced aeronautical technologies applied to both the airframe and the weapon can yield a strategic system with

- Increased survivability through increased speed, decreased operating altitude, extended range, and decreased observables
- Ability to launch super/hypersonic long-range standoff weapons to attack time critical targets
- 25-percent reduction in design gross weight for the same mission range.

For large military and civil transport aircraft, productivity and direct operating costs are figures of merit. Integrating advanced aeronautical technologies will provide

- Rapid worldwide deployment with 30-percent increase in productivity
- Twice the range/payload of the C-5A with only one-third more takeoff weight
- 20- to 40-percent reduction in maintenance hours per flight-hour
- 50- to 100-percent increase in fuel efficiency
- 30- to 45-percent reduction in direct operating costs
- 10- to 15-percent reduction in acquisition cost.

Applying advanced integrated technologies to military and civil rotorcraft will allow

- 100-percent speed and range increase
- Worldwide self-deployment capability
- 50-percent decrease in noise and vibration
- 25-percent reduction in fuel used for same mission
- 25- to 50-percent life-cycle-cost savings.

For cruise missiles and remotely piloted vehicles, survivability and range/payload are critical to mission success. Applying advanced integrated aeronautical technologies will provide

- o 60-percent increase in range for the same launch weight
- o 50-percent decrease in weight for the same range
- o Greatly increased survivability due to higher speed and lower observability
- o Viable intercontinental range cruise missiles.

The current projection of the Free World market for all civil aircraft is estimated to be $185 billion (FY 1982 dollars) in the next decade. U.S. military aviation procurement demands in the next decade are estimated to exceed $350 billion (FY 1982 dollars). Incorporation of these advanced technologies is expected to produce, by the year 2000, an increased military capability equivalent to $20 billion annually invested in additional units, as well as provide a continuing civil market advantage.

Our potential military adversaries and U.S. industries' commercial competitors are aggressively pursuing these and other opportunities. The U.S. government and industry must continue to maintain their leadership in aeronautical R&T or lose current military and economic advantages.

VII. NATIONAL GOALS IN AERONAUTICS

From the study group's examination of aeronautics--historical, current, and future--it is clear that a superior capability in aeronautics is a unique and vital asset to the national security and significantly influences U.S. international negotiating power. The critical reliance on superior aircraft for national defense and the position of civil aeronautics as a key manufacturing group for wartime mobilization and international travel, coupled with the aggressive foreign challenges in every aspect of aviation, warrant serious national attention. A review of policy statements and recommendations (contained in Chapter VII of Volume II) over the past 15 years shows consistent agreement with this finding.

A statement of national goals relative to aeronautics and aeronautical R&T forms a useful basis for the subsequent establishment and implementation of these R&T policies. The study group recommends the following national aeronautics and aeronautical R&T goals for government and industry.

Aeronautics

1. Maintain a superior military aeronautical capability.

The design, development, manufacture, and operation of military aircraft and their weapon systems are vital to the national defense. The constant ensurance of aeronautical superiority in terms of operational and combat effectiveness, survivability, dependability, and affordability for all types of military aircraft is a high-priority national goal.

2. Provide for the safe and efficient use of the national airspace system, vehicles operated within the system, and facilities required for those operations.

The air mode is a major component of the U.S. public transportation system. It is essential that the national air traffic control and navigation systems be equipped and operated effectively, and that aircraft airworthiness, airline operations, crew qualifications, and airport facilities be certified with paramount concern for public safety.

3. Maintain an environment in which civil aviation services and manufacturing can flourish.

A healthy, competitive industry for both military and civil products ensures the most cost-effective, technically advanced products and supports a healthy, up-to-date industrial base for military surge capability.

4. Ensure that the U.S. aeronautical industry has access to and is able to compete fairly in domestic and international markets consistent with U.S. export policy.

U.S. aeronautical products compete in a marketplace that is international and characterized by strong government involvement. Such government involvement is based on a need to protect the military and industrial base of individual countries. Foreign companies are generally wholly or partially government owned and are strongly influenced by government policymakers. Foreign government support takes the form of development subsidies, or low-interest loans, attractive sales financing and other sales inducements, directed flag airline procurement, embassy sales assistance, and direct support of research, technology, and development.

The U.S. government provides support for the U.S. aeronautics industry through the development and procurement of military aeronautical systems and funding of NASA and DOD aeronautical R&T, but it has traditionally avoided direct subsidies. Rather than try to match the form and substance of foreign government subsidies for the aeronautics industry, the U.S. government has, in addition to military procurement and R&T support, employed direct reactive actions, including EXIM Bank assistance for exporters, threat of/or imposition of countervailing duties in appropriate cases of trade distortive import penetration, and attempts to discipline the trading activities of other countries through the negotiation of international trade agreements and understandings. The GATT Agreement on Trade in Civil Aircraft is one such agreement; the OECD Arrangement on Official Export Credits (including its side agreements called the "Standstill" and the "Commonline") is another.

Aeronautical R&T

1. Ensure the timely provision of a proven technology base to support future development of superior U.S. aircraft.

Achievement of the stated goals of military superiority, a safe and efficient air transport system, and a favorable environment for civil aviation depends on improved productivity and advanced aeronautical technology.

2. Ensure the timely provision of a proven technology base for a safe, efficient, and environmentally compatible air transportation system.

This goal relates to the technology and technical data base required to operate the national airspace system and certify aircraft airworthiness. It includes the R&T required to improve and operate air traffic control and navigation systems equipment, and that required to establish a base of understanding to meet government responsibilities regarding airworthiness certification of new U.S. or foreign aircraft, including structural concepts and materials, advanced aerodynamics, propulsion, controls, and terminal-area operating systems.

VIII. GOVERNMENT ROLES IN AERONAUTICAL RESEARCH AND TECHNOLOGY

The analyses and formulation of policy regarding government roles in aeronautical R&T must be guided by the general policies for all government R&T as well as specific, pertinent considerations. Current administration policy guidance for direct government support of any form of R&T requires that

- The results of the project are required to support clearly established government responsibility.
- The benefits of the R&T are not likely to be appropriable by private firms, and such firms are not likely to undertake the project without additional incentive, and direct support is the most effective and efficient means of providing the needed incentive.
- Its priority is sufficiently high for it to successfully compete for available federal funds.

The panel, in formulating its recommendations, considered each of these general R&T policy criteria.

1. Is aeronautical R&T required to support a clearly established government responsibility?

Yes.

The United States relies heavily on aircraft for its national defense. The magnitude of this dependency is illustrated by the fact that approximately one-third of the DOD budget is for procurement, maintenance, and operation of aeronautical systems. In addition to its economic value, this civilian industry infrastructure provides an in-place (non-government funded) wartime mobilization capability important for national security. U.S. military planners have long depended on offsetting Soviet numerical superiority with fewer yet technologically superior vehicles. It is important to have the continued capability to support this dependence, since DOD believes this to be tactically and economically advantageous, thus providing the country with the best, most economical defense. Further, the national responsibility to provide a safe national airspace system requires continued R&T to meet changing requirements and needs.

The panel has chosen to express its recognition of this clear national responsibility through its recommendation for national aeronautical R&T goals.

2. Are the benefits of aeronautical R&T likely to be non-appropriable by private firms, and are such firms unlikely to undertake such research without additional incentive, and is direct support of aeronautical R&T the most effective and efficient means of providing adequate incentive for the foreseeable future?

   Yes.

The U.S. aeronautics industry has generally been able to capture the benefits of aeronautical R&T, as is apparent from the success of the products resulting from superior technology, such as the development of large commercial transports and U.S. military aircraft. Most of the civil aeronautical products now on the market are the result of development investments by industry. However, U.S. government investments have supported most aeronautical R&T on which industry has depended. For example, major aeronautical firms, such as Boeing, spend less than 1.0 to 1.5 percent of their privately funded R&D budget on aeronautical R&T development activities, which is defined as research ending 2 to 3 years before start of system development. Industry is, however, being further encouraged to increase their private R&D by the specific tax reductions and tax credits in the Reagan Administration's Economic Recovery Program. This is expected to motivate the growth of corporate sales and profits, which, in turn, is a principal means and motivation for further corporate investments in R&T.

However, some factors limit the extent of the aeronautics industry's private investment in R&T:

- There are commercially attractive investments that, even with the additional incentives provided by the Economic Recovery Program, may require financial resources that are beyond the ability of individual firms to generate or borrow.

- The benefits of some R&T development may be so widespread that specific applications may not be readily foreseen or the full value of the benefits may not be captured by individual firms within the characteristically long-time horizons typical of aeronautical R&T investments.

- The results of aeronautical R&T are often knowledge or expertise based and, therefore, very difficult to patent and protect for very long periods of time.

An obvious approach to the problem of wide application is for two or more firms to share the cost of the required R&T. However, many firms perceive ambiguities in the interpretation of antitrust statutes that inhibit attempts to establish joint ventures among domestic firms. These ambiguities lead to a risk that a joint venture, once initiated, may have to terminate if it is later judged to not comply with the requirements of the antitrust statutes. However, these inhibitions to domestic cooperative ventures in aeronautical R&T may be increasingly offset by recent federal guidelines that attempt to reduce the uncertainty surrounding the permissible conditions for cooperative R&T by domestic firms. Also, ongoing government efforts to examine changes to existing antitrust statutes may encourage greater cooperative investments by domestic firms in the future. The present condition that prevails, however, is that little or no domestic joint aeronautical R&T venturing exists.

Existing patent laws do not provide sufficient protection to enable private firms to dependably capture the value of private aeronautical R&T investments. The Reagan Administration is already considering strengthening U.S. patent laws, and these efforts may eventually encourage greater private investment in all research. The benefits of these proposed changes in patent laws will take many years to come to fruition, but the study group believes these efforts are worthwhile and should be encouraged.

The long time horizons, typical of aeronautical R&T investments, are also a key factor that makes private investment in aeronautical R&T unattractive to U.S. firms. These long times make it difficult to protect the research, plan and focus it for maximum results, and internally fund it against competing short-term corporate alternatives.

In summary, the study group recognizes that the preferred form of government support for industry generally, including the civil aeronautics industry, is the efforts reflected in the Economic Recovery Plan and long-range antitrust and patent law changes. These efforts will eventually allow reduced taxes and lower inflation, lower interest rates, increase economic growth, and provide greater patent protection, so that industry will have the means and incentive to make greater R&T investments that are in both the corporate and national interest. However, for many reasons, as well as the above, it was concluded that aeronautical R&T is sufficiently inappropriable to cause significantly lower private investment in such R&T than would be in the best national interest. Therefore, since leadership in aeronautical R&T is essential to our national security, U.S. government help is required to ensure that adequate national investments are made in aeronautical R&T.

The study group also notes the long and successful history of government-assisted aeronautical R&T now encompassed primarily by NASA's aeronautical R&T programs, and believes that there are currently no better nondirect and no other direct budgetary means for appropriate government support to aeronautics that would be superior to the current system. (See Chapter V and Appendix C of Volume II.)

3. Is the priority for government support of aeronautical R&T sufficiently high to compete for available federal funds?

Yes.

While the study group recognizes the urgent need to reduce government spending to achieve the objectives of the Economic Recovery Program, it unanimously concludes that a continued strong, government-budgeted program of aeronautical R&T is consistent with overall government priorities and should be maintained.

Funding stability is important to the long-term productivity of research in general and of aeronautics in particular. This should be an important consideration in developing future aeronautical R&T budgets.

Policy Alternatives

Using the above rationale, the study group considered alternatives for government roles in aeronautical R&T. For convenience, policy alternatives were separated into two areas: aircraft R&T and air transportation system R&T.

1. Aircraft R&T

Although the theoretical policy options range from no government role at all to complete government funding and conduct, three alternatives were considered in detail:

- Government support for military aeronautical R&T
- Government support for aeronautical R&T development and military aeronautical technology demonstration consistent with overall government priorities and availability of funds
- Government support for military and civil technology development and technology demonstration.

A key question has centered around a definition that would describe the type of R&T that is properly supported by the U.S. government, as distinguished from R&T that is properly supported privately. This distinction is not usually important in large-scale, defense-oriented aeronautical programs, because of the fundamental need for the taxpayers to provide for the common defense. When R&T programs become more applied in nature, however, many with experience in economics and government policy caution that careful distinctions are necessary for the U.S. government to avoid activities that are more properly done by the private sector.

The study group concluded that grounds for government support are more apparent where the aeronautical R&T is long term and/or high risk, and/or offers a potentially high payoff in areas of clear government priority and responsibility, such as national defense. The group also concluded that civil and military aeronautical R&T development was largely common. For these reasons and those discussed earlier, the study group concluded that aeronautical R&T development projects, for which the benefits are unlikely to be appropriable by private industry, are candidates for government support, subject to the overall needs and priorities of the government and the availability of funds.

The study group viewed government support of civil technology demonstration as generally inappropriate, if the work is within sight of near-term application and the benefits can be generally captured. Consequently, the study group recommended the second alternative, government support for aeronautical R&T development and military aeronautical technology demonstration, consistent with overall government priorities and availability of funds.

2. Air Transportation System R&T

The government has statutory responsibility to ensure the safety of the air transportation system. The FAA performs this function and also supports R&T programs involving national airspace activities.

As discussed in Chapter I of Volume II, the national airspace activities, although important, are excluded from this study because they can be conducted almost exclusive of the air vehicle. This study focuses on the vehicle aspects of air transportation R&T.

The Administrator of the FAA has described the requirement for a data base on this subject and the FAA's reliance on NASA to provide it. (See Chapter VII of Volume II.) Therefore, the current policy regarding aeronautical and air transportation system R&T is completely consistent with the preferred government goal and role in aeronautical R&T.

Alternative Methods of Implementing Government Roles

Preliminary analyses resulted in the following alternatives.

1. DOD, as the Customer, Conducts All Aeronautics R&T.

This alternative was not recommended, because DOD is a mission-oriented "requirements" agency with a focus on near-term projects. Resources would be concentrated in this area to the detriment of both the long-range military aeronautical and civil aviation R&T needs.

2. Establish a Separate, Government Aeronautical R&T Agency.

The study group found very little duplication between NASA and DOD R&T programs and facilities, and concluded that the advantages of combining major elements of the present DOD/NASA aeronautical R&T organizations were minimal. Further, there would be strong pressure from DOD to address military applications, with the result that the new agency would soon become dominated by DOD and thus experience the shortcomings discussed in Alternative 1.

3. Privatize Programs and Facilities.

The key problem with privatization is designing and administering a subsidy/incentive scheme that would encourage sufficient long-term and broad-based aeronautical R&T, disseminate the results, and avoid unwarranted and costly duplication. Also, a significant reason for establishing DOD laboratories is to maintain in-house expertise so that the military can be "smart buyers" of technically complex aircraft weapon systems. It is not possible to develop a competent technical staff through contract monitoring alone.

4. Maintain Present Institutional Framework.

Under this alternative, the U.S. government role is implemented by the following:

- DOD funds, directs, and implements technology development and demonstration programs directed specifically toward military applications.
- NASA funds, directs, and implements R&T development programs and supports military technology demonstration programs.
- NASA and DOD encourage transfer of aeronautical research results to and within U.S. industry as effectively as possible.
- Both DOD and NASA manage, maintain, and operate aeronautical research, development, test, and evaluation facilities.
- FAA, with NASA and DOD support, is responsible for air traffic control and safety-related R&T.

The following arguments favor this approach:

- Specific and timely military aeronautical R&T needs are provided by DOD technology development and demonstration programs.
- A broad technology base is provided by NASA R&T development programs, the results of which can be used by industry in meeting both military and civil aeronautical vehicle needs, as appropriate.
- NASA's reservoir of technical expertise and research infrastructure would be preserved. The independent research framework provides the necessary stimulus and incentives to sustain a cadre of researchers. Incentives in the other approaches would ultimately be based more on near-term cost-schedule-performance criteria, which would cause a decrease in research and technical development output and eventual loss of skilled staff.

- NASA's independence is an asset that enables free transfer of information among government and industry and provides a long-term perspective free from short-term development and operational pressures.

The study group recommends maintaining the present institutional framework to implement the U.S. government role in developing aeronautical R&T. Only this approach can ensure all of the following:

- DOD needs will be met.
- Aeronautics results will be freely interchanged within the U.S. industrial community.
- Technology required to meet the long-term requirements of both civil and military aircraft is developed.
- The United States will more nearly maximize the productivity of aeronautical R&T.

IX. AERONAUTICAL FACILITIES

The foundation for advancement in aeronautical science has been the development of continually improving research and test facilities. From its origin, research in aeronautics has depended on the ability to simulate flight conditions in a controlled, realistic, stable manner in order to measure and understand the phenomena being investigated.

The capital investment required for necessary aeronautical facilities has grown to such magnitude in terms of complexity and sophistication as to require centralization. This contrasts with most other high-technology endeavors in which the basic tools required for research and design are much less costly and thus proliferate through the private sector.

Although individual, privately owned wind tunnels and propulsion test facilities do exist, only the federal laboratory system now has the composite capability sufficient to support the full requirements of research, design, and testing for a state-of-the-art aeronautical system. The current replacement value of DOD and NASA facilities is estimated to be 8 to 10 billion dollars. When combined with the researchers associated with the facilities, the federal laboratory system forms a national asset that is the foundation for maintaining U.S. preeminence in aeronautics.

The study group examined the capability, capacity, and limitations of the U.S. aeronautical facilities and is convinced that, with minor exceptions, existing and planned major facilitities are adequate and will not require replacements in the near future. Continued maintenance, improved productivity, and modernization will be required. Improvements to computational capability should be specifically considered.

An area of concern surfaced during the examination of the aeronautical facilities. The approach to operational funding support for the wind tunnels and the corresponding user charges that are imposed by DOD has resulted in reduced activity in certain DOD facilities. The policy of direct cost recovery from users of DOD facilities when compared to the NASA policy of no charge to any user except for proprietary industrial testing has caused a migration, when possible, to NASA facilities.

The study group strongly believes that selecting the most appropriate facility for either research or system development testing should be based on mission priorities and/or technical requirements and not on the funding policies. High-quality R&T requires more support, and low-quality R&T should be eliminated. Consequently, the group recommends that

- o NASA and DOD develop a common framework of appropriate incentives and proper joint management coordinating mechanisms to ensure that the use of NASA and DOD aeronautical facilities is consistent with government priorities and the needs of the user programs.

X. TECHNOLOGY TRANSFER

Because identification of specific application is lacking, the majority of R&T development is carried out and reported openly in the United States. Significance to a military system, the primary basis for classification and control, is usually identified only after the basic concepts have been discussed openly.

The Soviets and our commercial competitors expend significant effort on the acquisition, analysis, and internal distribution of U.S. aeronautical technical data. The superb efficiency of the U.S. secondary distribution systems in worldwide dissemination of U.S. government-sponsored reports and the potential application of this valuable technology to ~~a critical~~ foreign military or civil system suggest a need to reassess policies regarding the dissemination of aeronautical technical data.

Several procedures exist to control dissemination of unclassified but critical dual-use technology, such as the commodity control list maintained by the Department of Commerce for export control and the munitions control list maintained by the Department of State. The most appropriate application of these procedures or the development of a new process more precisely tuned to controlling the DOD/NASA unclassified technology data will require further analysis. The study group strongly concluded that such a study be undertaken as rapidly as possible to recommend a national policy on this subject. Such policy should not inhibit or discourage government-approved international cooperation or research exchanges at the university level. To facilitate definition of the policy, the study group recommends that

- NASA and DOD, in conjunction with other government and non-government agencies, review the procedures for disseminating aeronautical R&T documents.

The study group recognized that foreign countries are developing a considerable amount of aeronautical R&T. The U.S. government currently has no central organization to collect the best unclassified foreign R&T and disseminate it to both government and industry users, a role formerly performed by NACA. The collection, translation, and analysis requires expert knowledge. Therefore, the study group further recommended that

- NASA provide a plan for a centralized means of collecting unclassified aeronautical R&T documents, conference proceedings, and meeting results.

APPENDIX A

OSTP STUDY GROUP ON AERONAUTICAL RESEARCH AND TECHNOLOGY POLICY

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The Boeing Company

APPENDIX B

OSTP STUDY GROUP ON AERONAUTICAL RESEARCH AND TECHNOLOGY POLICY

WORKING GROUP MEMBERS

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Office of Management and
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OSTP - STAFF

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APPENDIX C

INDUSTRY RESPONDERS TO OSTP QUESTIONNAIRE DATED 18 MARCH 1982

AIAA (Society)
AOPA (Association)
ATA (Association)
Beech
Bell Helicopter
Boeing Company
Detroit Allison
Fairchild
Garrett
Gates Learjet
General Dynamics
General Electric
Gulfstream American
Grumman
Lockheed
McDonnell
Northrop
Pratt and Whitney
Rockwell
Sikorsky
Teledyne
Vought